

Ambient Air Quality Assessment Studies
Carried out in the Elliot Lake Area

January, 1982 - March 1984

Technical Support Section
Northeastern Region
Ontario Ministry of the Environment

NER-AQTM 16-85

July, 1985

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SUMMARY

Particulate monitoring carried out in the Elliot Lake area using the high-volume and dustfall sampling techniques by the Ontario Ministry of the Environment from January, 1982 to March, 1984, indicate that particulate levels in ambient air have remained within acceptable levels.

Comparison of levels of radionuclides in suspended particulate with control locations in the Northeastern Region indicate that of the four parameters examined only uranium was slightly higher in the Elliot Lake area.

High-volume and dustfall sampling indicates that 1982-1983 levels of particulate are comparable to 1976-1977 levels when the monitoring program in the Elliot Lake area was initiated.

Analysis results of samples collected by the Ontario Ministry of Labour using the time integrating monitoring technique during 1982 are also included in this report.

INTRODUCTION

The Ontario Ministry of the Environment has monitored ambient air quality in the Elliot Lake area since 1976. Two air quality reports have been published; one covering the period from 1976 to 1980, and the second covering 1981. These two reports also summarize data collected by Denison Mines Limited and the Ontario Ministry of Labour.

The Ontario Ministry of the Environment continues to monitor air quality in the Elliot Lake area and results of data collected from January, 1982 to March, 1984, are presented in this report. Data collected by the Ontario Ministry of Labour during 1982 are also presented.

MONITORING NETWORK

The Ontario Ministry of the Environment

The Ontario Ministry of the Environment collected information on airborne particulate matter at six locations from January, 1982 to March, 1984 using the high-volume (hi-vol) sampling technique and at nine locations using the dustfall technique. Locations of monitoring sites are included on the attached map (Figure 1). The location of the Porridge Lake hi-vol monitor which began operation in late 1984 is also shown in Figure 1.

Meteorological information has been continually collected at the Mid-Canada communications tower on Hwy 108 from November, 1983. Information collected includes wind speed, wind direction and temperature at the 100'(33m) level.

The Ontario Ministry of Labour

The Ontario Ministry of Labour collected ambient radon daughter concentration data at four locations during 1982 using the time integrating technique. These monitors were collocated at four of the hi-vol sites operated by the Ministry of the Environment.

MONITORING TECHNIQUES

The primary sources of anthropogenic emissions of particulate in the Elliot Lake area are the mining and milling processes, vehicular traffic and wind-blown particulate from tailings areas, roadways and gravel pits. Two methods used for measuring particulate are the hi-vol and the dustfall jar techniques.

High-Volume Sampling

The high-volume (hi-vol) sampling technique determines the mass concentration of suspended airborne particulate (less than 100 microns) by drawing a known volume of air through a pre-weighted filter medium. Standard operation of the sampler involves air flow rates from 0.9 to 1.4 cubic meters per minute and the use of a Gelman AE glass fibre filter. The sample is collected over a 24-hour period, midnight to midnight, every six days. The six-day operating schedule is pre-determined and is consistent throughout Canada and the United States. This six day sampling is considered to be representative of the air quality over a year.

Two criteria for desirable air quality exist for total suspended particulate matter. One is 120 micrograms of suspended particulate per cubic meter of air ($\mu\text{g}/\text{m}^3$) averaged over a 24-hour period. The other is an annual geometric mean of 60 $\mu\text{g}/\text{m}^3$. The 24-hour criterion is based on impaired visibility and adverse health effects (in combination with sulphur dioxide), while the annual criterion is based on public awareness of suspended particulate and subsequent aesthetic effects.

High-volume samples collected in the Elliot Lake area have also been analyzed for radionuclides including: gross α , gross β , radium²²⁶, lead²¹⁰ and uranium. At the present time, there are no criteria for radionuclides in ambient air but the results are useful to determine trends and to compare levels from one area to another.

Dustfall Sampling

The dustfall jar sampling technique is used to determine the amount of settleable particulate matter and provides an indication of the amount of large particulate in the air. The particulate collected using the dustfall jar technique is usually greater than 20 microns. The technique is subject to variability and loss of

material because of air currents and precipitation during the collection period.

The dustfall collector consists of a polyethylene jar measuring approximately 30 cm high by 15 cm in diameter. The jar, which contains a plastic liner, is left exposed to the atmosphere for approximately 30 days attached to a pole, three to five meters above the ground. The weight of the material collected is expressed as grams per square meter per 30 days ($\text{g}/\text{m}^2/30 \text{ days}$).

Two criteria for total dustfall exist. One is $7 \text{ g}/\text{m}^2/30 \text{ days}$ for a 30-day period, while the other is an annual mean of $4.5 \text{ g}/\text{m}^2/30 \text{ days}$ for a one-year period. Both dustfall criteria are based on aesthetic considerations, since particulate greater than 20 microns does not readily enter the human respiratory tract.

Meteorological Data

Meteorological data was obtained from the Ministry of the Environment operated equipment located on the Mid-Canada communications tower on Hwy 108 approximately 5 km north of the Town of Elliot Lake. Wind speed, wind direction, and ambient temperature are measured continuously at the 33m (100 foot) level. Due to numerous problems with equipment and data telemetry, meteorological data is only available from November, 1983 through to March, 1984.

Radon Daughter Monitoring

The time integrating monitoring technique, used by the Ontario Ministry of Labour, measures the concentration of radon daughters in ambient air. This is carried out by drawing a known volume of air through a filter for four to six weeks. Alpha radiation emitters are trapped on the filter and their subsequent radioactive decay results in permanent tracks on a plastic detector. After etching the detector, the number of alpha tracks are counted under a microscope and converted to Working Levels (WL).

MONITORING RESULTS

High-Volume Sampling

Total Suspended Particulate.

From January, 1982 to March, 1984, total suspended particulates were monitored at six locations in the Elliot Lake area. These locations are shown on the attached map (Figure 1), along with the Porridge Lake site which began operation in late 1984. Results of total suspended particulate analysis are presented in Table 1 and Figures 2 to 7. Figures 2 to 7 include pre-1982 data collected at each site for comparison purposes. The number of cases when the total suspended particulate levels exceeded the 24-hour criterion of 120 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) decreased from 10 to 0 from 1982 to 1984. The annual geometric mean of $60 \mu\text{g}/\text{m}^3$ was not exceeded at any of the sites during the same time. The highest number of exceedances of the 24-hour criterion occurred at the Esker Lake (71026) and the Stollery Lake (71063) locations with 2 and 6 exceedances respectively. The Esker Lake Station (71026) was discontinued in October, 1982 and the Stollery Station (71063) was discontinued in April, 1983, when the residents of these mobile home parks were re-located. The annual geometric mean for total suspended particulate has decreased slightly at the other four locations from 1982 to 1983. The apparent decrease in 1984 is due to the fact that particulate levels in the first quarter of the year are usually the lowest due to snowcover.

Radionuclides.

Radionuclide concentrations were monitored at six hi-vol locations in the Elliot Lake area. Analysis results from April, 1981 to March, 1984 are presented in Tables 2 to 6. Also included in these tables are analysis results for control locations in Sault Ste. Marie, Sudbury and North Bay. Since there are no provincial criteria for radionuclides in suspended particulate, samples were

analyzed at these three control locations to determine if radionuclides are higher in the Elliot Lake area. Arithmetic means of radionuclides in ambient air were calculated using numerous values which were at or below the detection limit. In these cases the detection limit was used for calculating the means. The nature of the analysis and improvements in procedures both at the Radiation Protection Laboratories, where gross α , gross β , radium²²⁶ and lead²¹⁰ analysis are carried out, and at the Ministry of the Environment laboratories, where uranium analysis are carried out, have resulted in variations in the detection limits since this monitoring program began in 1976.

Since the majority of samples analysed in the Elliot Lake area and at control locations contain radionuclides at or below the detection limit a variation in detection limits could be mistakenly interpreted as a change in mean ambient radionuclide concentrations.

Limits of detection used in this report are as follows:

Gross α	0.005 to 1.43 mBq/m ³
Lead ²¹⁰	0.007 to 0.24 mBq/m ³
Radium ²²⁶	0.004 to 0.017 mBq/m ³
Gross β	0.006 mBq/m ³
Uranium	0.001 to 0.005 ug/m ³

One must therefore exercise caution when comparing radionuclides between locations and at the same location over time.

Gross α .

Values for gross α analysis on hi-vol filters (Table 2) range from a low of 0.411 milliBequerels per cubic meter (mBq/m³) at Esker Lake in 1981 to a high of 1.449 mBq/m³ at Hillside Drive in 1984. These values are not consid-

ered higher than those reported at control locations. The increase in the mean levels of gross α at all locations within the Northeastern Region is likely due to modifications in sample preparation and analysis techniques with resulting changes in detection limits.

Gross β .

Mean values (Table 3) for Gross β analysis in the Elliot Lake area range from $0.7\text{mBq}/\text{m}^3$ at Hillside Drive (71020) in 1982 to $4.6\text{ mBq}/\text{m}^3$ at Quirke Townsite (71023) in 1982. Gross β values decreased slightly from 1981 through 1984 in the Elliot Lake area and do not appear to be higher than at the control locations.

Radium²²⁶.

A slight decrease in radium²²⁶ values was observed during the 1981 to 1984 period in the Elliot Lake area (Table 4). Values range from a low of $0.024\text{ mBq}/\text{m}^3$ at Quirke Townsite (71023) in 1983 to a high of $0.474\text{ mBq}/\text{m}^3$ at the same location in 1982. A slight decrease in radium²²⁶ values was observed from 1981 to 1984. Radium²²⁶ mean values were not significantly higher in the Elliot Lake area than at control locations.

Lead²¹⁰.

Mean values for lead²¹⁰ in suspended particulate were low and showed no trends during the 1981 to 1984 period (Table 5). Mean values range from a high of $1.034\text{ mBq}/\text{m}^3$ at Hillside Drive (71020) in 1981 to a low of $0.112\text{ mBq}/\text{m}^3$ at Stollery Lake (71063) during the same year. The Hillside Drive data contains two atypical readings which have increased the yearly mean. The mean value is reduced to $0.514\text{ mBq}/\text{m}^3$ when these two high readings are rejected. Lead²¹⁰ values in the Elliot Lake area do not appear to be different from those recorded at control locations.

Uranium.

Mean values for total uranium (Table 6) appear to fluctuate during the 1982-1984 period in the Elliot Lake area. Values ranged from a high of 0.012 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) at Denison Townsite (71053) in 1981 to below detection limits at Hillside Drive (71020) in 1982. Uranium levels appear somewhat higher in the Elliot Lake area than at control locations in the Northeastern Region.

Dustfall Sampling

Total Dustfall

Total dustfall was monitored at nine locations from January, 1982 to February, 1984 (see Figure 1). Mean dustfall values ranged from a high of 11.9 grams per square meter for 30 days ($\text{g}/\text{m}^2/30 \text{ days}$) at Stanrock Tailings SE (71052) during 1982 to a low of 0.6 $\text{g}/\text{m}^2/30 \text{ days}$ at Kilborn Way (71028) in 1984 (Table 7). Dustfall data for each individual monitoring location from 1976 to 1984 are presented in Figures 8 to 17. Pre-1982 data is included for trend analysis.

The yearly criterion of $4.5 \text{ g}/\text{m}^2/30 \text{ days}$ was exceeded in 1982 and 1983 at Nordic Tailings S (71025) and once at Stanrock Tailings SE (71052) in 1982.

The monthly provincial criterion of $7.0 \text{ g}/\text{m}^2/30 \text{ days}$ was exceeded on 10 occasions during 1982 and four occasions during 1983. No exceedances were recorded during the first 2 months of 1984.

In general, dustfall levels indicate that settleable particulate in the Elliot Lake area has remained at or returned to 1976-1977 levels. Lower values observed at all locations in 1984 are not indicative of a lowering trend since only two samples were collected at each location and total dustfall is traditionally lower during snow cover periods.

Meteorological Data

A summary of the meteorological data collected at the Mid-Canada communications tower on Hwy 108 is included in Figures 18 to 21. Figure 18 summarizes the mean monthly temperature from November, 1983 to March 1984. Figures 19, 20 and 21 show the frequency of wind direction for wind speeds above 6 km/hour during the same time period.

Radon Daughter Monitoring

During 1982, outdoor concentrations of radon daughters were monitored by the Ontario Ministry of Labour at four locations in the Elliot Lake area using time integrating monitors. The four monitors were collocated at Ministry of the Environment hi-vol sampling sites at Quirke Townsite (71023), Denison Townsite (71024), Nordic Townsite (71054) and Hillside Drive in Elliot Lake (71020).

Results of the radon daughter monitoring program are included in Appendix A.

Future Monitoring Program

The particulate data collected since 1976 has not identified significant problems with air quality in the Elliot Lake area. Since expansion of the mines and townsites is essentially complete, a reduction in the amount of monitoring appears to be warranted.

At the Elliot Lake Provincial Coordinating Committee meeting of May 2, 1984, the Ministry of the Environment proposed to curtail the air monitoring program as follows:

- a) Discontinue the total dustfall monitoring program which consisted of 9 sites on May 2, 1984.
- b) Discontinue suspended particulate monitoring (hi-vol sampling) at the Quirke and Nordic townsites and at Hillside Drive in Elliot Lake; maintain the

suspended particulate and radiological monitoring program at the Denison Townsite and at the newly commissioned station in the Porridge Lake subdivision of the Town of Elliot Lake.

- c) Maintain operation of the meteorological tower north of the Town of Elliot Lake.

The Committee agreed with the proposal, with the understanding that the program would be enhanced in the future if warranted. Consequently, the monitoring program was curtailed as proposed.

DJB/R-46

Table 1

SUMMARY OF TOTAL SUSPENDED PARTICULATE DATA
IN THE ELLIOT LAKE AREA FROM
JANUARY, 1982 to MARCH, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED			ANNUAL GEOMETRIC MEAN ($\mu\text{g}/\text{m}^3$)			MAXIMUM 24 HOUR VALUE ($\mu\text{g}/\text{m}^3$)			NUMBER OF SAMPLES ABOVE PROVINCIAL CRITERION 24 h		
	1982	1983	1984	1982	1983	1984	1982	1983	1984	1982	1983	1984
Hillside Drive (71020)	50	41	2	35	30	16	118	188	23	0	1	0
Quirke Townsite (71023)	55	37	11	24	21	10	293	131	33	1	2	0
Denison Townsite (71053)	52	46	13	21	19	7	176	79	21	1	0	0
Nordic Townsite (71054)	51	46	11	19	18	10	50	91	30	0	0	0
Esker Lake (71061)	34	Discontinued October, 1982		29	---	---	237	---	---	2	---	---
Stollery Lake (71063)	45	12	Discon- tinued April/83	35	22	---	415	66	---	6	0	---
Total	287	182	37							10	3	0

--- Data unavailable

Provincial Criteria:

Annual: 60 $\mu\text{g}/\text{m}^3$ (geometric mean)
24 hour: 120 $\mu\text{g}/\text{m}^3$

Table 2

SUMMARY OF GROSS α ANALYSIS IN TOTAL SUSPENDED PARTICULATE
 IN THE ELLIOT LAKE AREA
 FROM JANUARY, 1981 to MARCH, 1984
 COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED				ARITHMETIC MEAN (mBq/m ³)				MAXIMUM VALUE (mBq/m ³)			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
Hillside Drive (71020)	31	15	29	2	0.880	0.622	0.476	1.449	2.914	1.573	1.430	1.467
Quirke Townsite (71023)	50	10	27	11	0.577	0.824	0.675	1.434	2.769	1.345	1.666	1.590
Denison Townsite (71053)	37	---	39	13	0.591	---	0.792	1.430	1.282	---	2.289	1.430
Nordic Townsite (71054)	40	24	38	11	0.589	0.602	0.735	1.430	1.787	2.003	1.573	1.430
Esker Lake (71061)	25	11	Discon- tinued Sept/82	---	0.411	0.502	---	---	1.503	1.004	---	---
Stollery Lake (71063)	30	40	1	Discon- tinued Jan/83	0.623	0.803	0.501	---	2.038	2.038	0.501	---
<u>CONTROL STATIONS</u>												
Land Registry Office Sault Ste. Marie (71049)	---	23	29	Discon- tinued Sept/83	---	0.557	0.284	---	---	1.573	0.586	---
OPP Station North Bay (75010)	35	10	12	17	0.577	0.359	0.219	1.447	2.084	0.952	0.644	1.716
Ash Street Sudbury (77016)	52	15	11	Discon- tinued May/83	0.514	0.621	0.343	---	2.266	1.259	0.915	---

--- Data unavailable
 No Provincial Criterion

Table 3

SUMMARY OF GROSS β ANALYSIS IN TOTAL SUSPENDED PARTICULATE
IN THE ELLIOT LAKE AREA
FROM APRIL, 1981 to MARCH, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED				ARITHMETIC MEAN (mBq/m ³)				MAXIMUM VALUE (mBq/m ³)			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
Hillside Drive (71020)	56	38	25	2	3.0	0.7	1.0	1.4	11.1	3.2	2.5	1.5
Quirke Townsite (71023)	54	43	24	11	4.6	3.0	1.5	1.4	24.0	71.2	4.1	1.6
Denison Townsite (71053)	58	40	33	13	3.2	2.0	2.1	1.4	12.9	22.5	17.9	1.4
Nordic Townsite (71054)	53	51	33	11	3.0	1.0	1.7	1.4	15.2	3.7	4.8	1.4
Esker Lake (71061)	35	34	Discontinued October, 1982		1.2	1.3	---	---	4.8	3.4	---	---
Stollery Lake (71063)	34	45	12	Discon- tinued April/83	1.8	1.2	1.8	---	5.2	3.4	5.9	---
<u>CONTROL STATIONS</u>												
Land Registry Office Sault Ste. Marie (71049)	5	25	Discon- tinued Dec/82	---	0.3	0.6	---	---	0.7	3.3	---	---
OPP Station North Bay (75010)	9	21	12	17	1.3	1.6	0.1	1.4	2.2	3.7	0.3	1.4
Ash Street Sudbury (77016)	32	46	33	Discon- tinued Dec/83	2.4	1.4	1.1	---	5.5	3.8	4.0	---

--- Data unavailable
No Provincial Criterion

Table 4

SUMMARY OF RADIUM ²²⁶ ANALYSIS IN TOTAL SUSPENDED PARTICULATE
IN THE ELLIOT LAKE AREA
FROM JANUARY, 1981 to MARCH, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED				ARITHMETIC MEAN (mBq/m ³)				MAXIMUM VALUE (mBq/m ³)				
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984	
Hillside Drive (71020)	31	15	29	2	0.049	0.014	0.365	0.029	1.233	0.074	0.987	0.029	
Quirke Townsite (71023)	50	10	27	11	0.292	0.474	0.024	0.032	0.963	0.701	0.172	0.064	
Denison Townsite (71053)	50	---	39	13	0.031	---	0.049	0.036	0.434	---	0.229	0.114	
Nordic Townsite (71054)	48	24	38	11	0.046	0.026	0.015	0.043	0.283	0.215	0.080	0.143	
Esker Lake (71061)	30	11	Discontinued September 1982		0.056	0.228	---	---	0.135	0.148	---	---	
Stollery Lake (71063)	19	12	1	Discon- tinued Jan/83		0.082	0.031	0.036	---	0.200	0.133	0.036	---
<u>CONTROL STATIONS</u>													
Land Registry Office Sault Ste. Marie (71049)	---	23	29	Discon- tinued Sept/83	---	0.025	0.017	---	---	0.243	0.157	---	
OPP Station North Bay (75010)	34	10	12	17	0.015	0.017	0.016	0.035	0.136	0.124	0.113	0.129	
Ash Street Sudbury (77016)	52	15	11	Discon- tinued May/83	0.032	0.023	0.031	---	0.108	0.148	0.286	---	

--- Data unavailable
No Provincial Criterion

Table 5

SUMMARY OF LEAD 210 ANALYSIS IN TOTAL SUSPENDED PARTICULATE
IN THE ELLIOT LAKE AREA
FROM JANUARY, 1981 to MARCH, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED				ARITHMETIC MEAN (mBq/m ³)				MAXIMUM VALUE (mBq/m ³)			
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984
Hillside Drive (71020)	50	15	29	2	*1.034	0.316	0.365	0.611	16.918	0.915	0.987	0.763
Quirke Townsite (71023)	50	10	27	11	0.254	0.473	0.540	0.531	0.963	0.741	1.179	1.081
Denison Townsite (71053)	50	---	39	13	0.239	---	0.396	0.294	1.007	---	1.059	0.801
Nordic Townsite (71054)	48	24	38	11	0.292	0.376	0.527	0.275	1.073	1.044	1.316	0.644
Esker Lake (71061)	30	11	Discon- tinued Sept/82	-	0.421	0.228	---	---	1.058	0.600	---	---
Stollery Lake (71063)	30	3	1	Discon- tinued Jan/83	0.112	0.193	0.358	---	0.221	0.286	0.358	---
<u>CONTROL STATIONS</u>												
Land Registry Office Sault Ste. Marie (71049)	---	23	29	Discon- tinued Sept/83	---	0.320	0.299	---	---	0.672	1.187	---
OPP Station North Bay (75010)	34	10	12	17	0.296	0.197	0.140	0.312	1.016	0.501	0.230	0.672
Ash Street Sudbury (77016)	52	15	11	Discon- tinued May/83	0.248	0.516	0.345	---	0.842	0.756	0.515	---

* Mean is 0.514 mBq/m³ when calculated without high values of 16.918 and 10.087 mBq/m³

-- Data unavailable - No Provincial Criterion

Table 6

SUMMARY OF URANIUM IN TOTAL SUSPENDED PARTICULATE
IN THE ELLIOT LAKE AREA
FROM APRIL, 1981 to MARCH, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED				ARITHMETIC MEAN (0.001 ug/m ³)				MAXIMUM VALUE (0.001 ug/m ³)				
	1981	1982	1983	1984	1981	1982	1983	1984	1981	1982	1983	1984	
Hillside Drive (71020)	35	34	41	2	1	<1	1	2	6	2	11	5	
Quirke Townsite (71023)	37	43	35	11	5	3	4	2	22	20	14	8	
Denison Townsite (71053)	41	40	47	13	12	8	11	2	124	53	125	11	
Nordic Townsite (71054)	40	37	45	11	3	1	2	2	17	8	25	5	
Esker Lake (71061)	35	31	Discontinued September/82		2	1	---	---	8	5	---	---	
Stollery Lake (71063)	34	32	12	Discon- tinued April/83		2	1	1	---	13	3	4	---
<u>CONTROL STATIONS</u>													
Land Registry Office Sault Ste. Marie (71049)	5	38	53	Discon- tinued Dec/83		<1	<1	<1	---	<1	5	2	---
OPP Station North Bay (75010)	4	22	23	28	<1	<1	<1	5	<1	6	1	5	
Ash Street Sudbury (77016)	26	33	32	Discon- tinued Dec/83		1	<1	<1	---	4	1	2	---

--- Data unavailable
No Provincial Criterion

Table 7

SUMMARY OF TOTAL DUSTFALL DATA IN THE
ELLIOT LAKE AREA FROM
JANUARY, 1982 TO FEBRUARY, 1984
COLLECTED BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

LOCATION	NUMBER OF SAMPLES COLLECTED			ARITHMETIC MEAN OF DUSTFALL LEVELS (g/m ² /30 days)			MAXIMUM VALUE (g/m ² /30 days)			NUMBER OF SAMPLES ABOVE PROVINCIAL CRITERION		
	1982	1983	1984	1982	1983	1984	1982	1983	1984	1982	1983	1984
Hillside Drive (71020)	12	10	2	2.5	2.9	1.1	4.3	6.2	1.3	0	0	0
Quirke Townsite (71023)	12	10	2	1.6	2.0	0.7	2.8	5.9	0.7	0	0	0
Denison Townsite (71024)	12	10	2	3.9	1.9	0.8	16.2	3.2	0.8	2	0	0
Nordic Tailings (S) (71025)	9	8	2	<u>4.7</u>	<u>4.5</u>	0.9	10.8	11.0	1.0	3	1	0
Stanrock Tailings (E) (71026)	12	6	Discon- tinued Aug/83	2.0	2.4	---	5.4	4.7	---	0	0	---
Stanrock Tailings (NW) (71027)	12	10	2	1.8	1.9	0.7	5.3	4.7	0.8	0	0	0
Kilborn Way (71028)	12	9	2	2.4	3.1	0.6	4.8	9.8	0.8	0	1	0
Roman Avenue (71029)	10	10	2	3.0	2.5	0.8	13.2	8.2	0.9	1	1	0
Stanrock Tailings (SE) (71052)	11	10	2	<u>11.9</u>	3.7	0.7	68.9	8.2	0.8	4	1	0
TOTAL Provincial Criteria:	<u>102</u>	<u>83</u>	<u>16</u>							<u>10</u>	<u>4</u>	<u>0</u>
	7.0	g/m ² /30 days	(30 day period)									
	4.5	g/m ² /30 days	(1 year mean)									
	<u>underlined</u> values exceeded the yearly criterion											

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

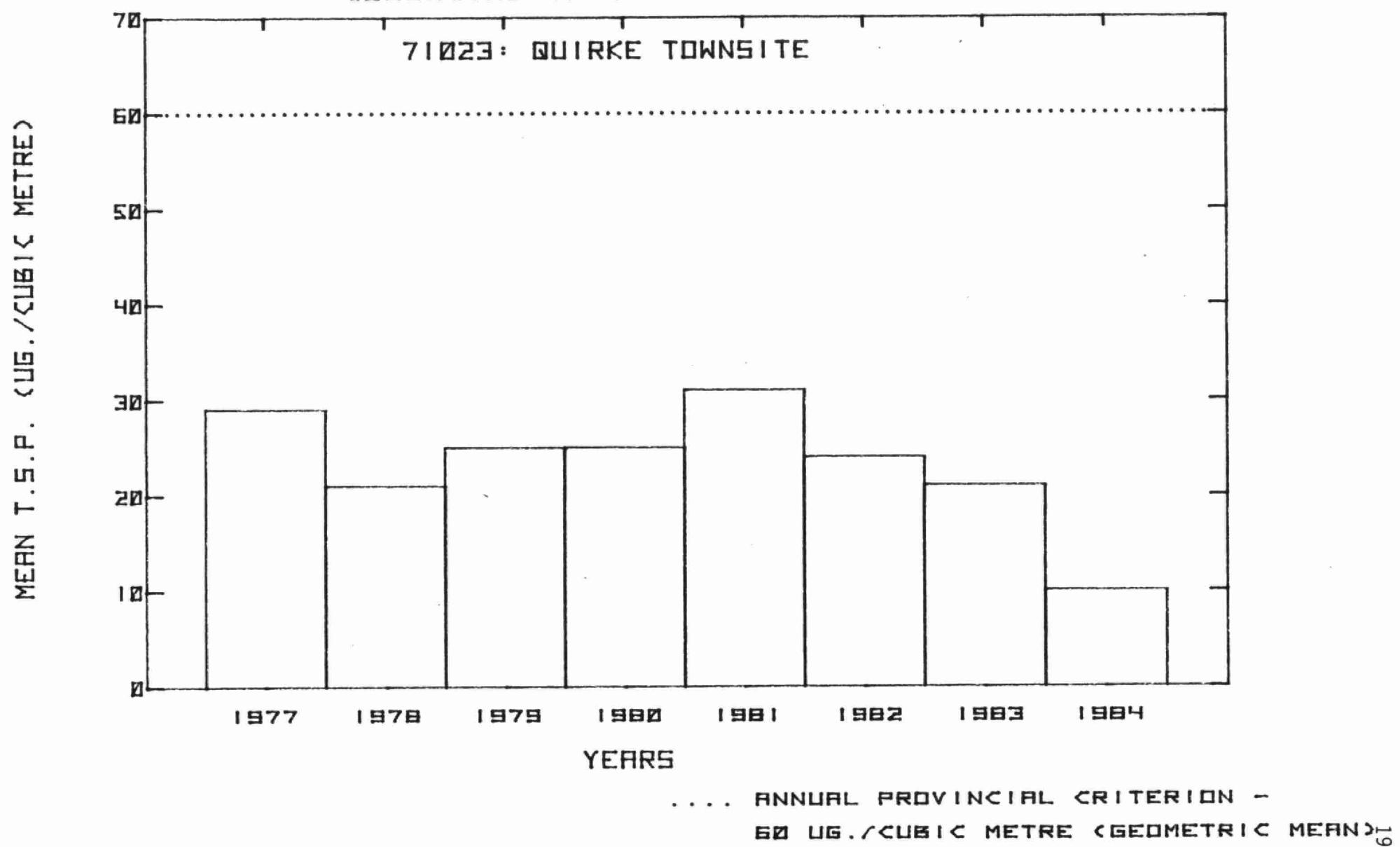


FIG. 2.

PERIOD: JAN/1977 TO MAR/1984

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

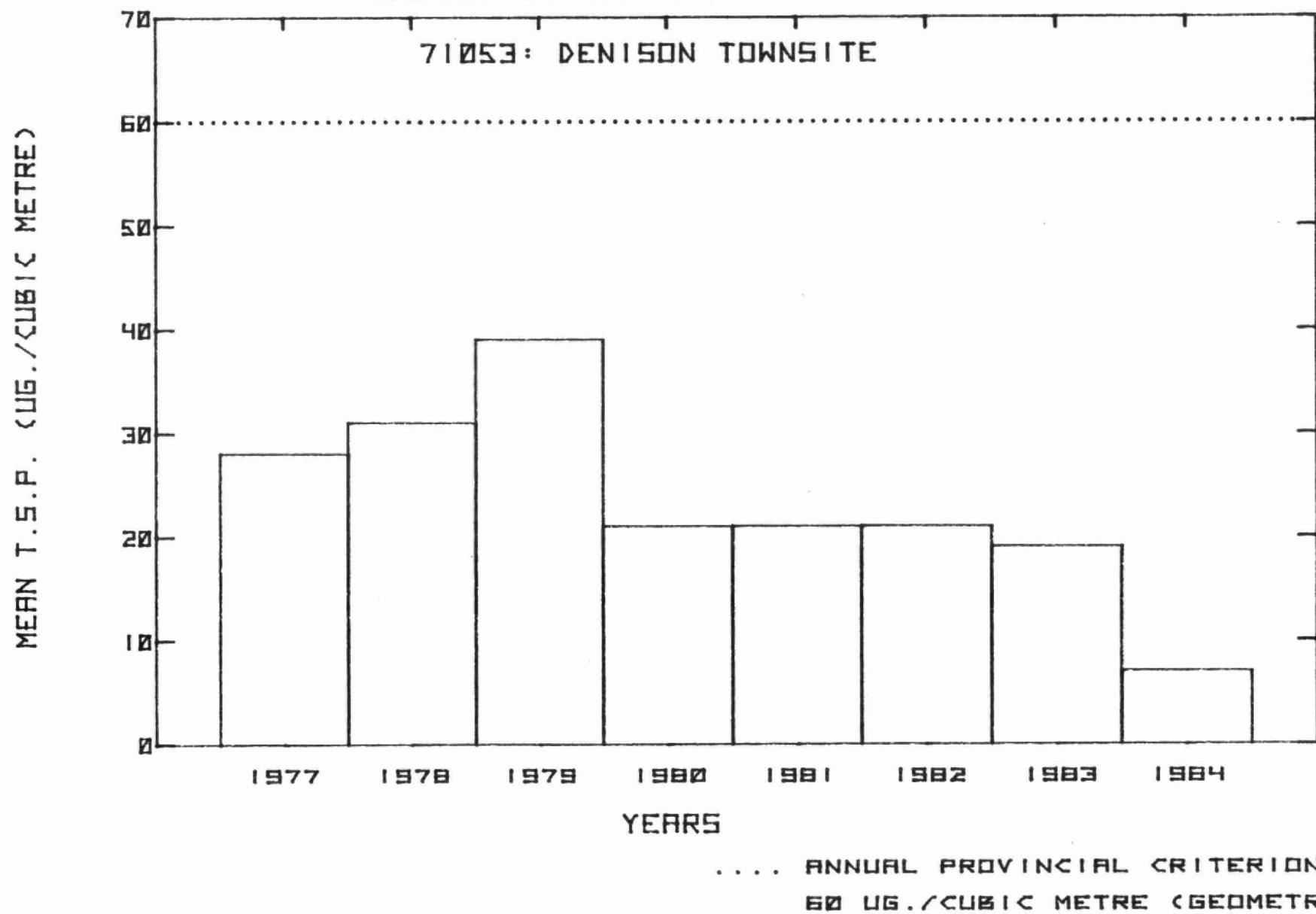


FIG. 3 .

PERIOD: JAN/1977 TO MAR/1984

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

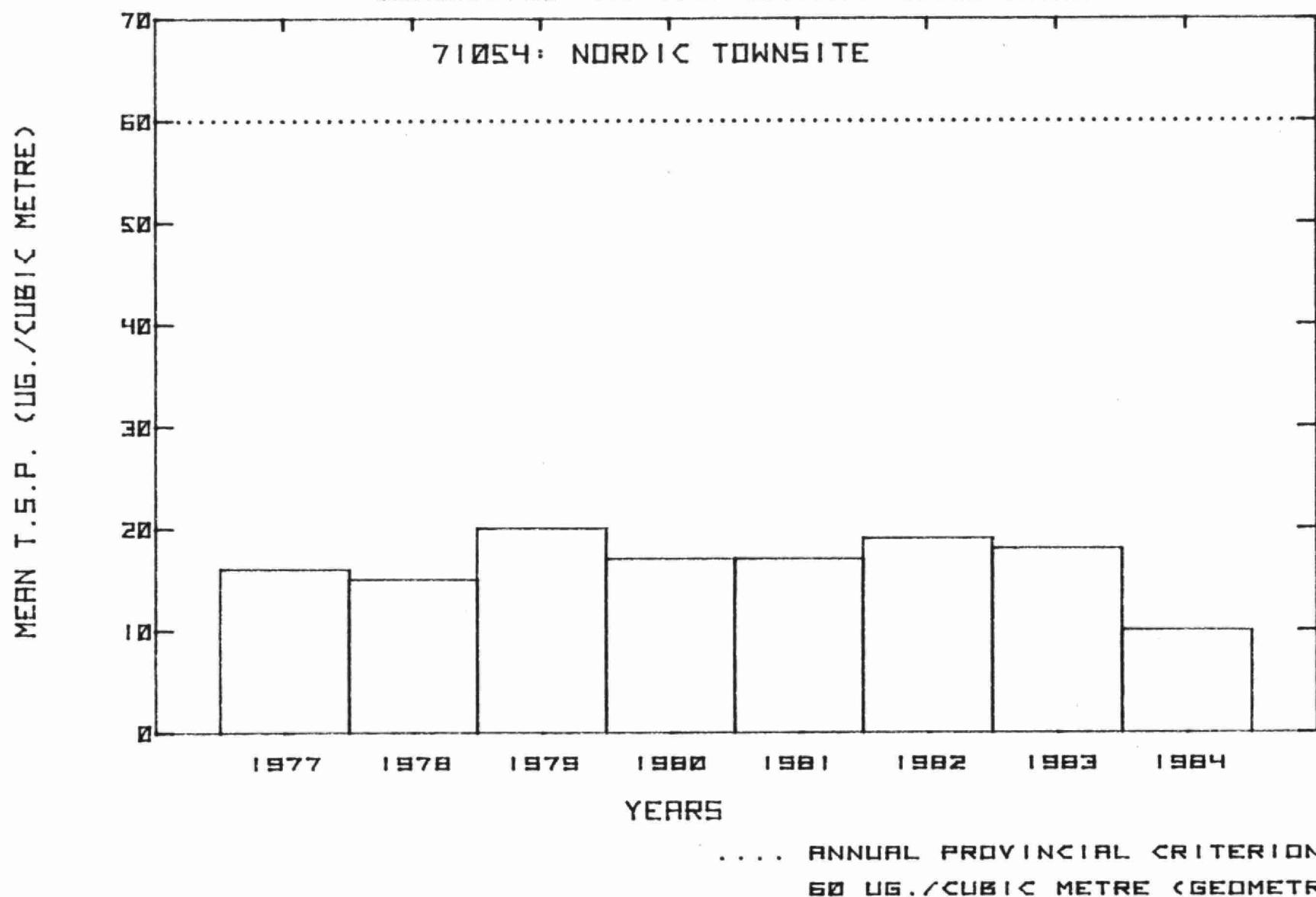


FIG. 4.

PERIOD: JAN/1977 TO MAR/1984

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

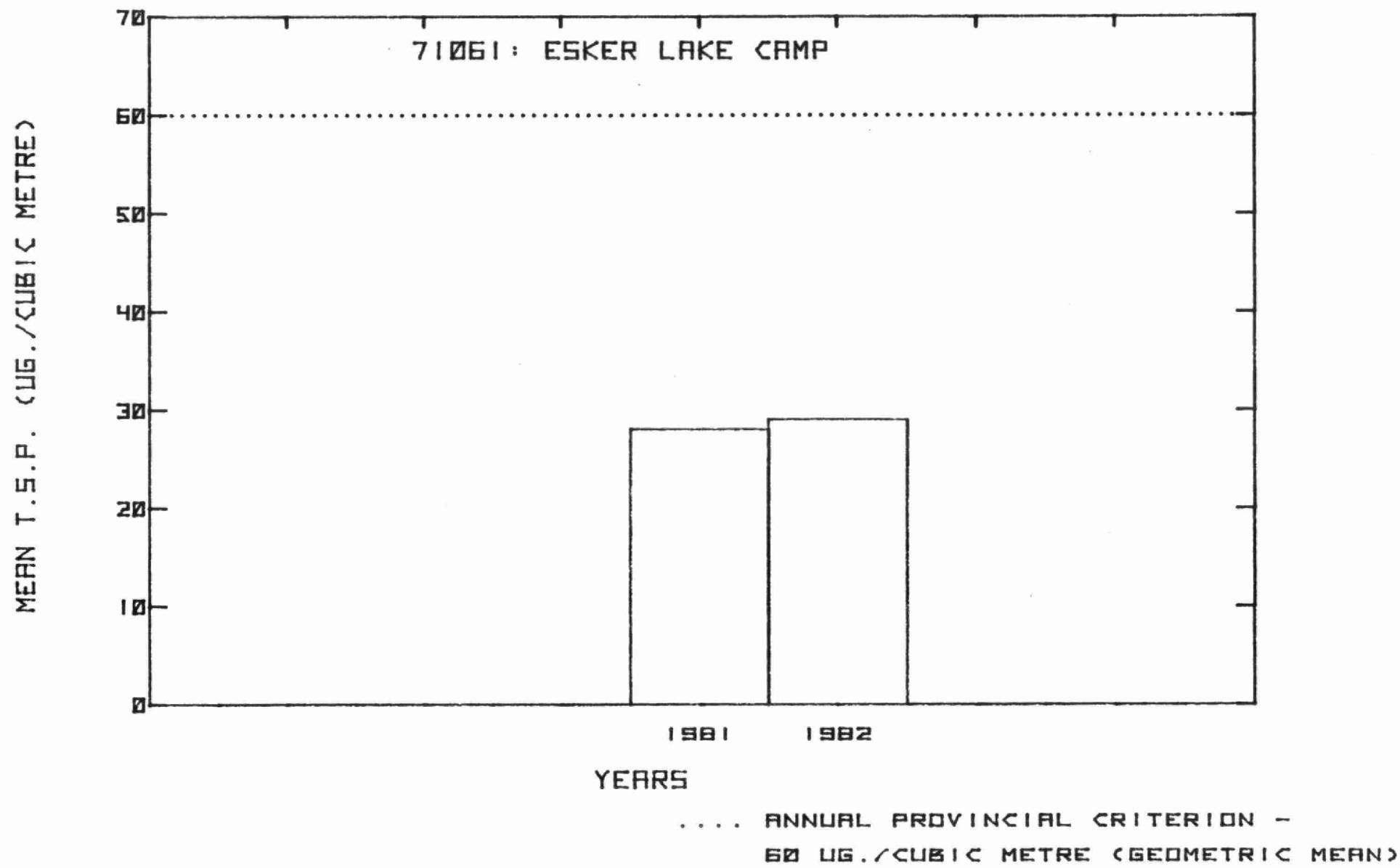


FIG. 5 .

PERIOD: JUNE/1981 TO OCT/1982

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

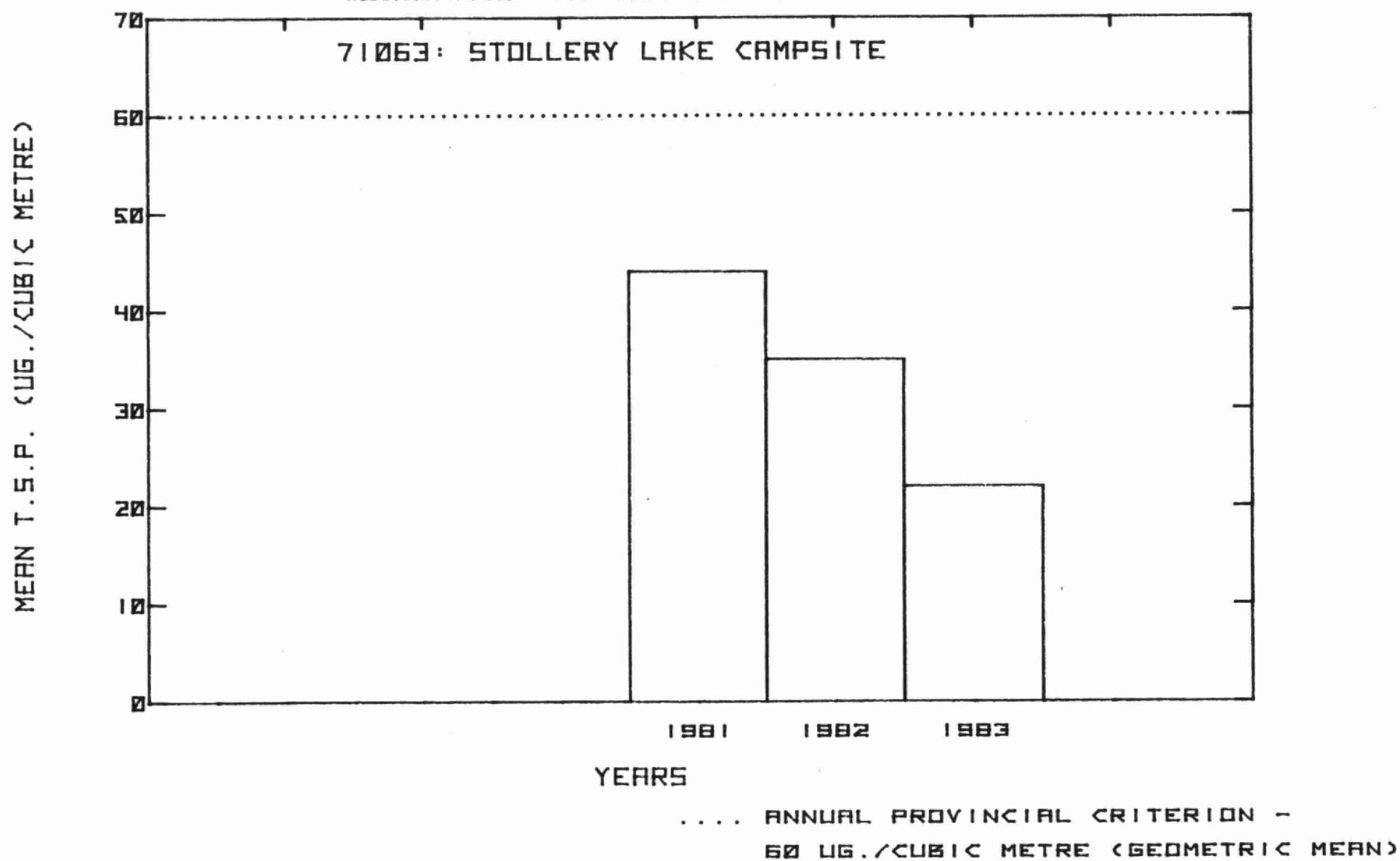


FIG. 6 .

PERIOD: JUNE/1981 TO APR/1983

ANNUAL GEOMETRIC MEAN OF T.S.P. LEVELS
COLLECTED IN THE ELLIOT LAKE AREA

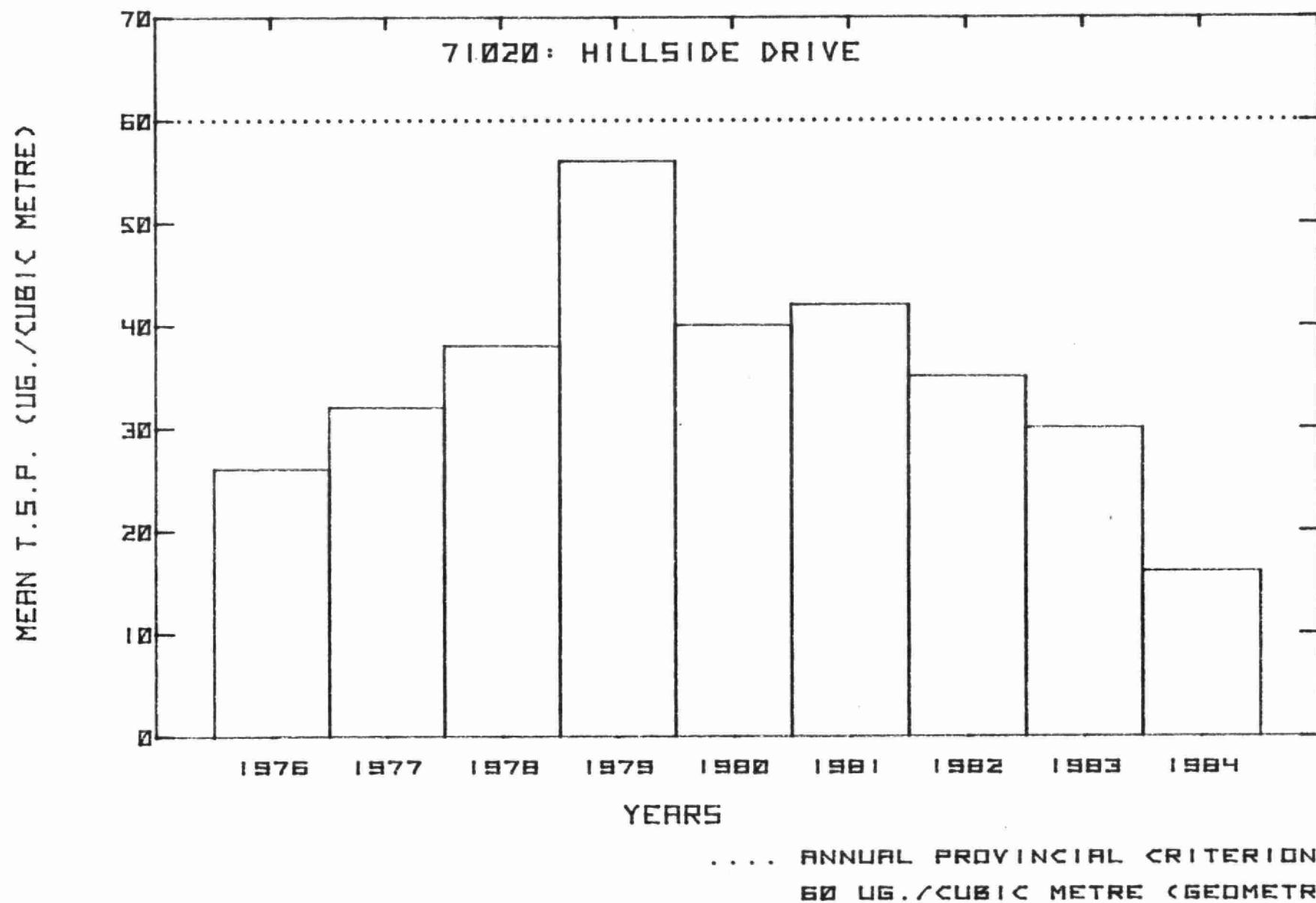


FIG. 7

PERIOD: NOV/1976 TO JAN/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

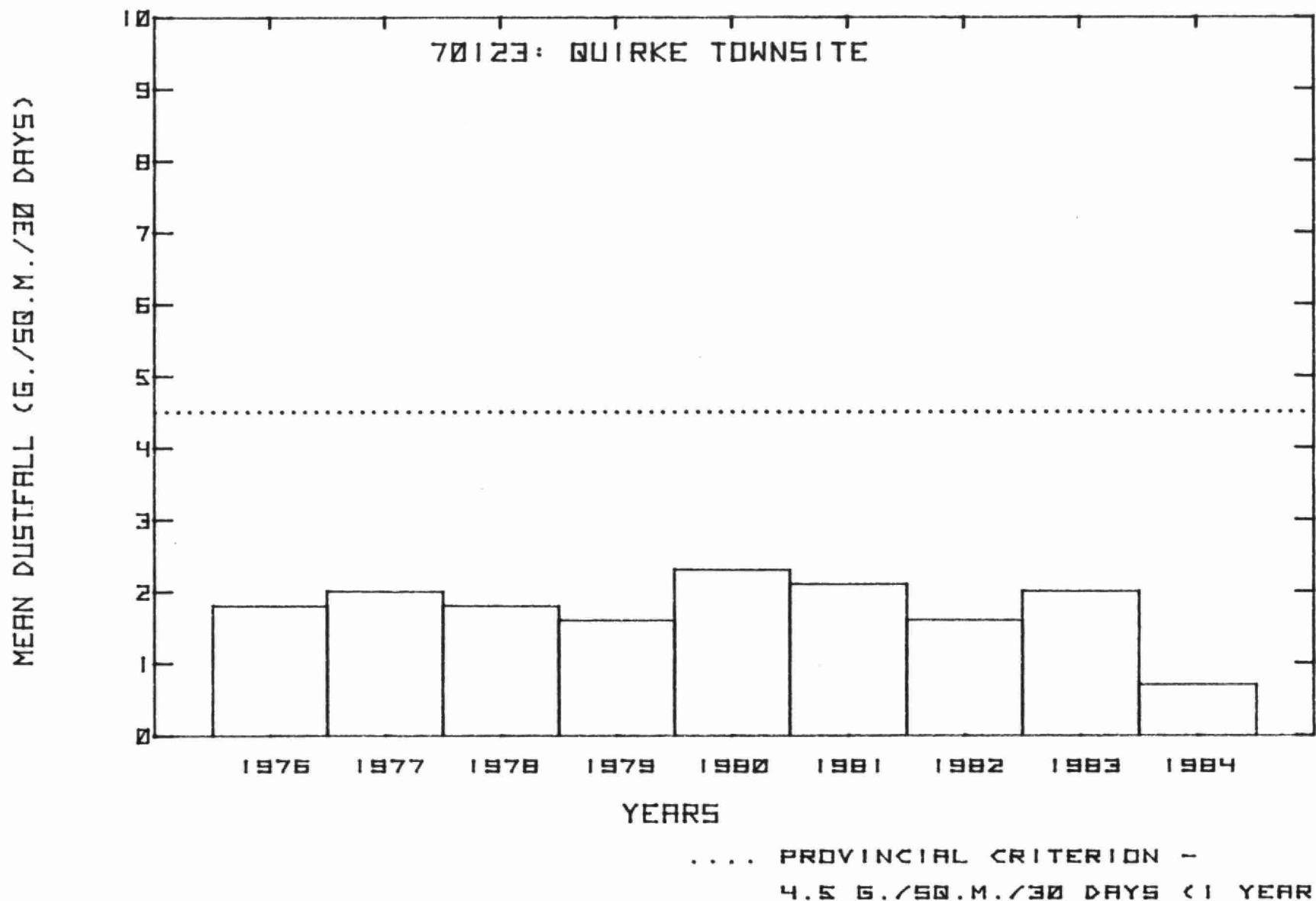
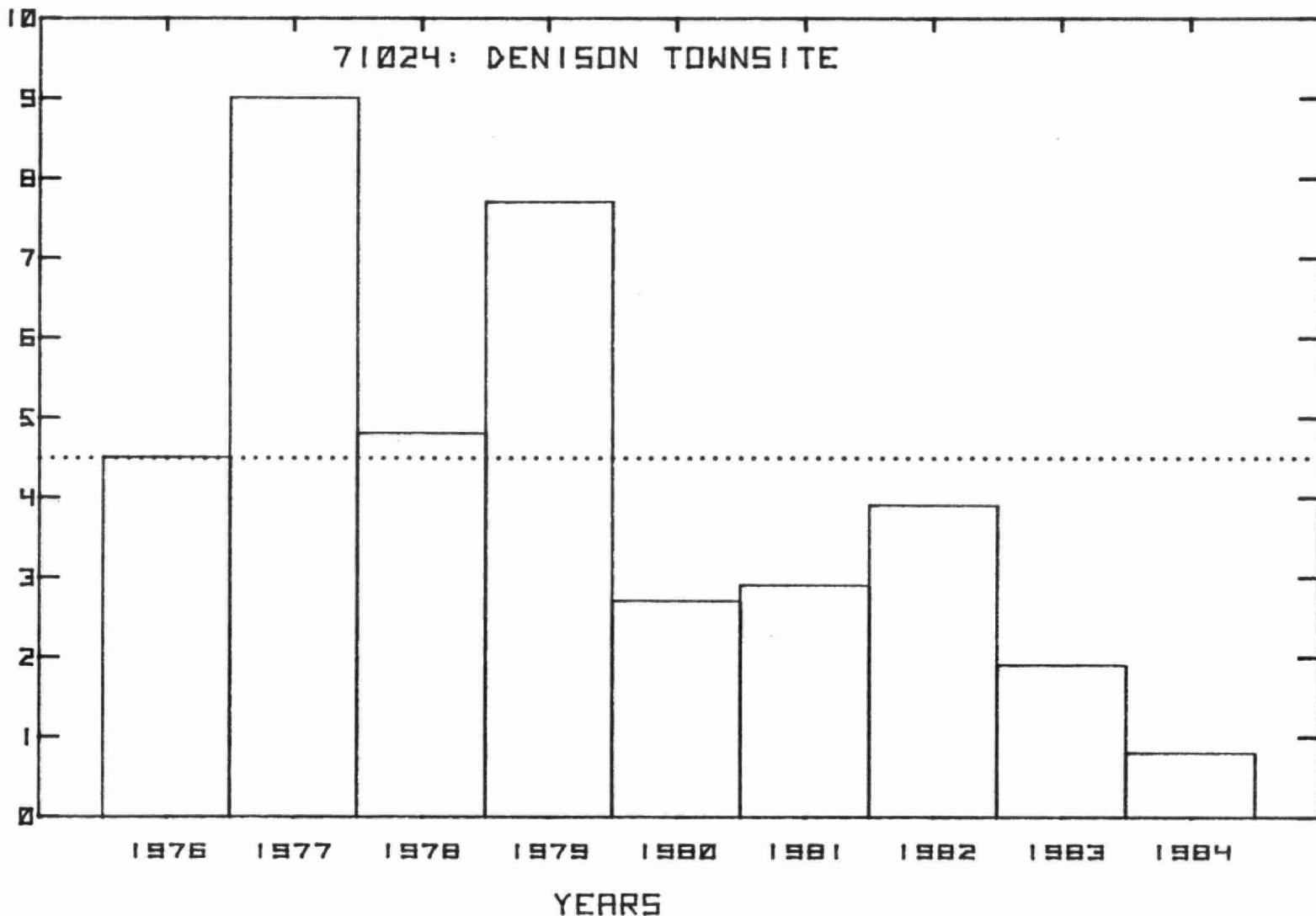


FIG. 8.

PERIOD: AUG/1976 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

MEAN DUSTFALL (G./SQ.M./30 DAYS)



YEARS

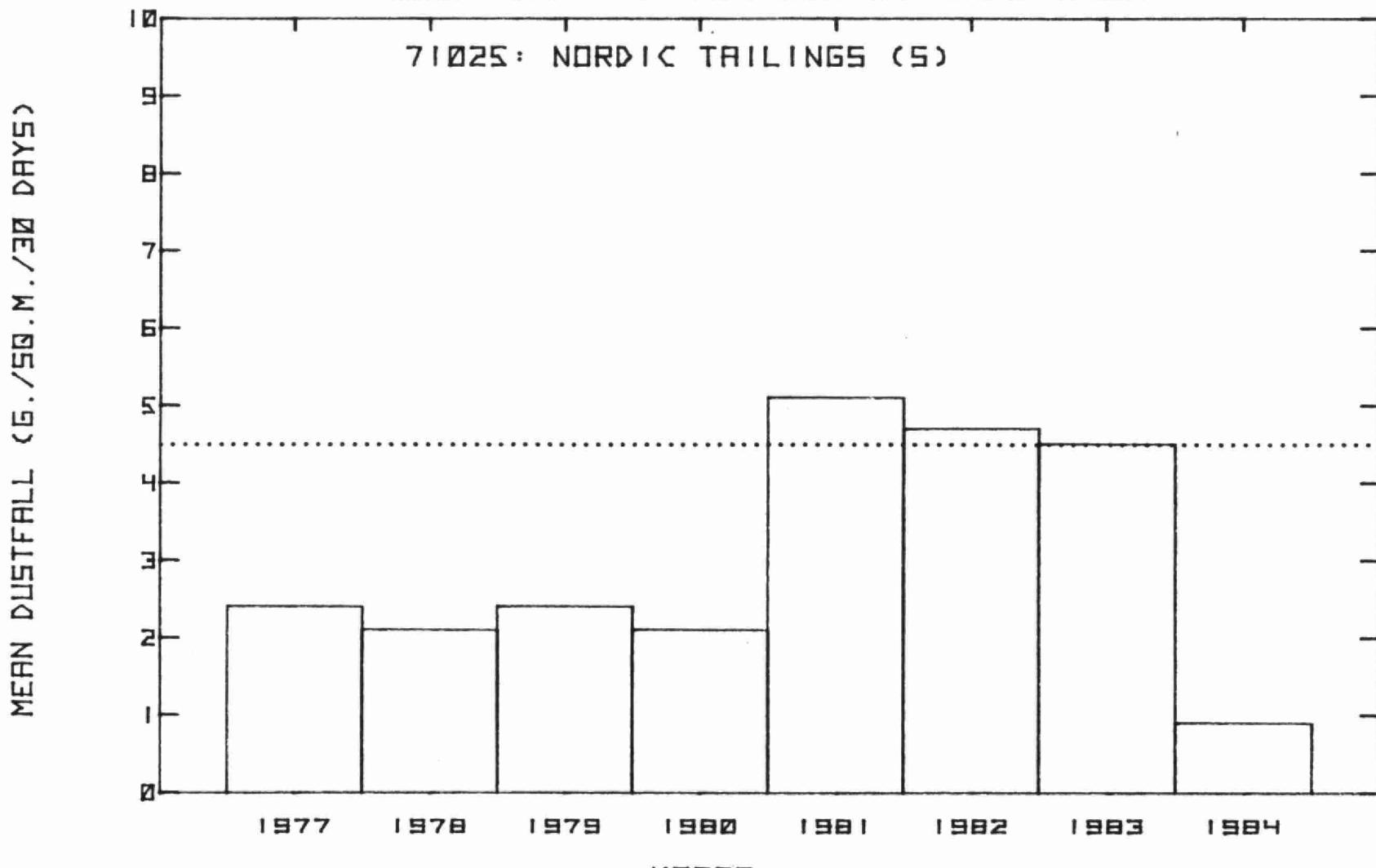
..... PROVINCIAL CRITERION -

4.5 G./SQ.M./30 DAYS (1 YEAR PERIOD)

FIG. 9.

PERIOD: AUG/1976 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

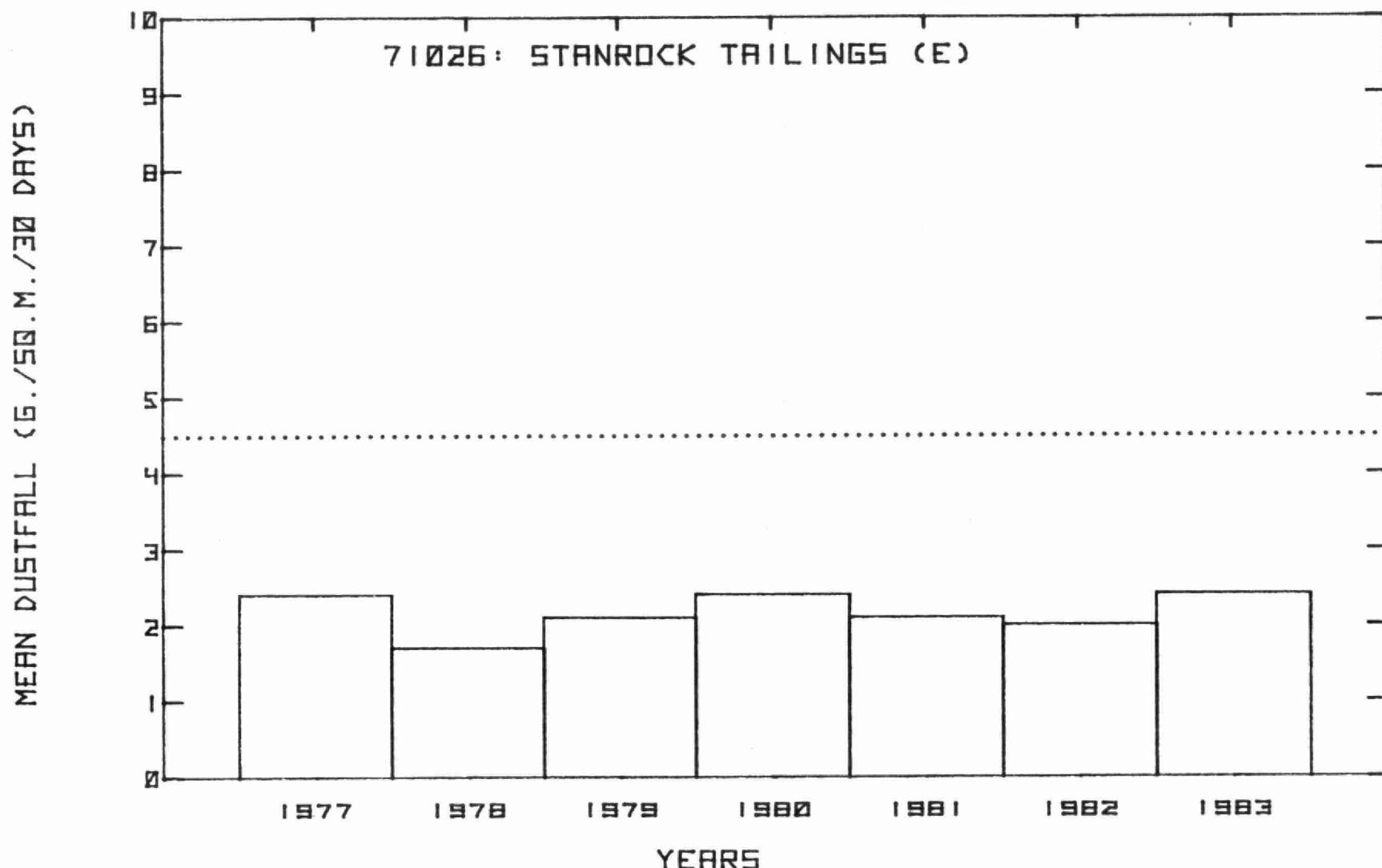


.... PROVINCIAL CRITERION -
4.5 G./SQ.M./30 DAYS (1 YEAR PERIOD)

FIG. 10.

PERIOD: JAN/1977 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA



YEARS

.... PROVINCIAL CRITERION -

4.5 G./SQ.M./30 DAYS (1 YEAR PERIOD)

FIG. 11.

PERIOD: JAN/1977 TO AUG/1983

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

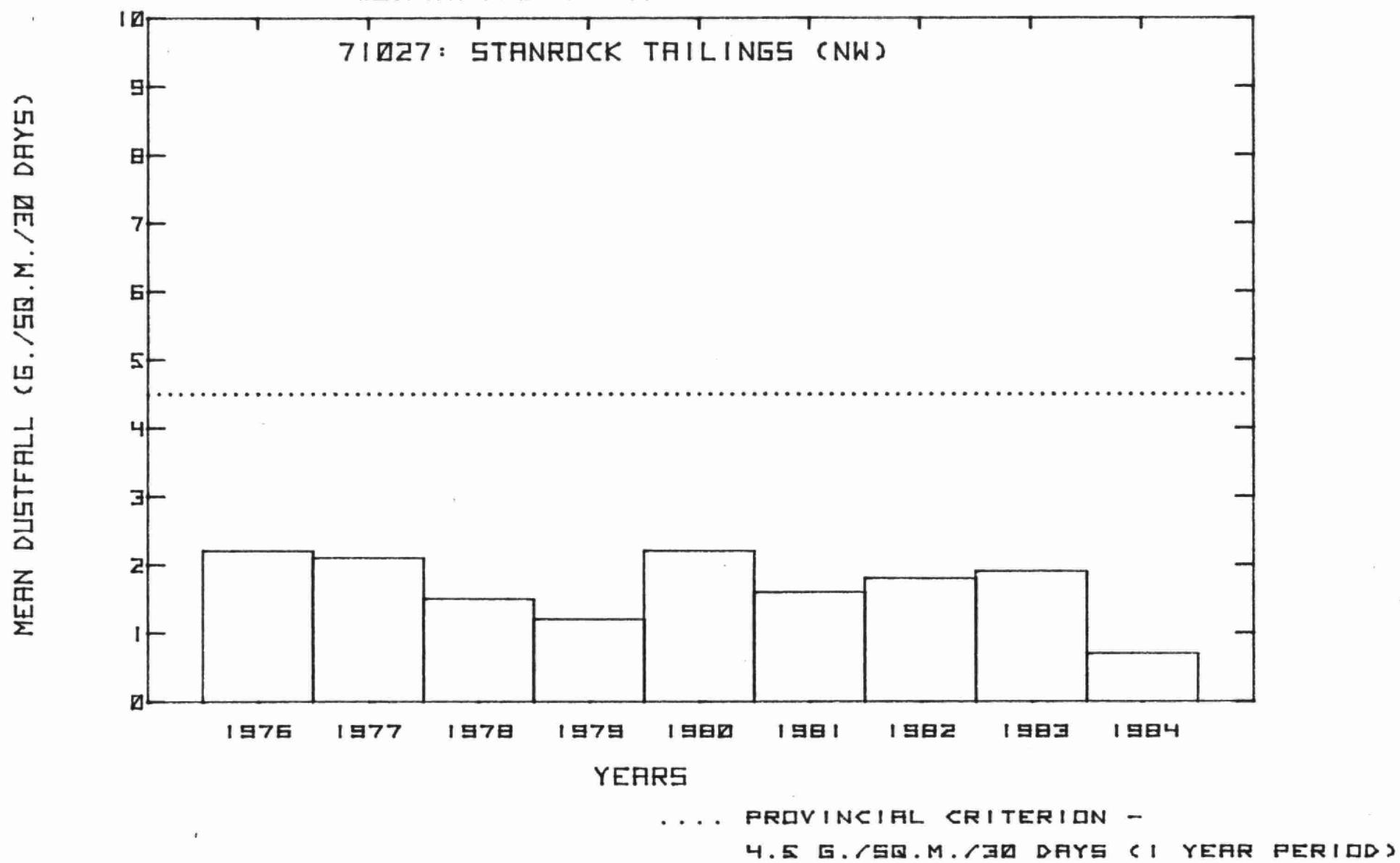


FIG. 12.

PERIOD: AUG/1976 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

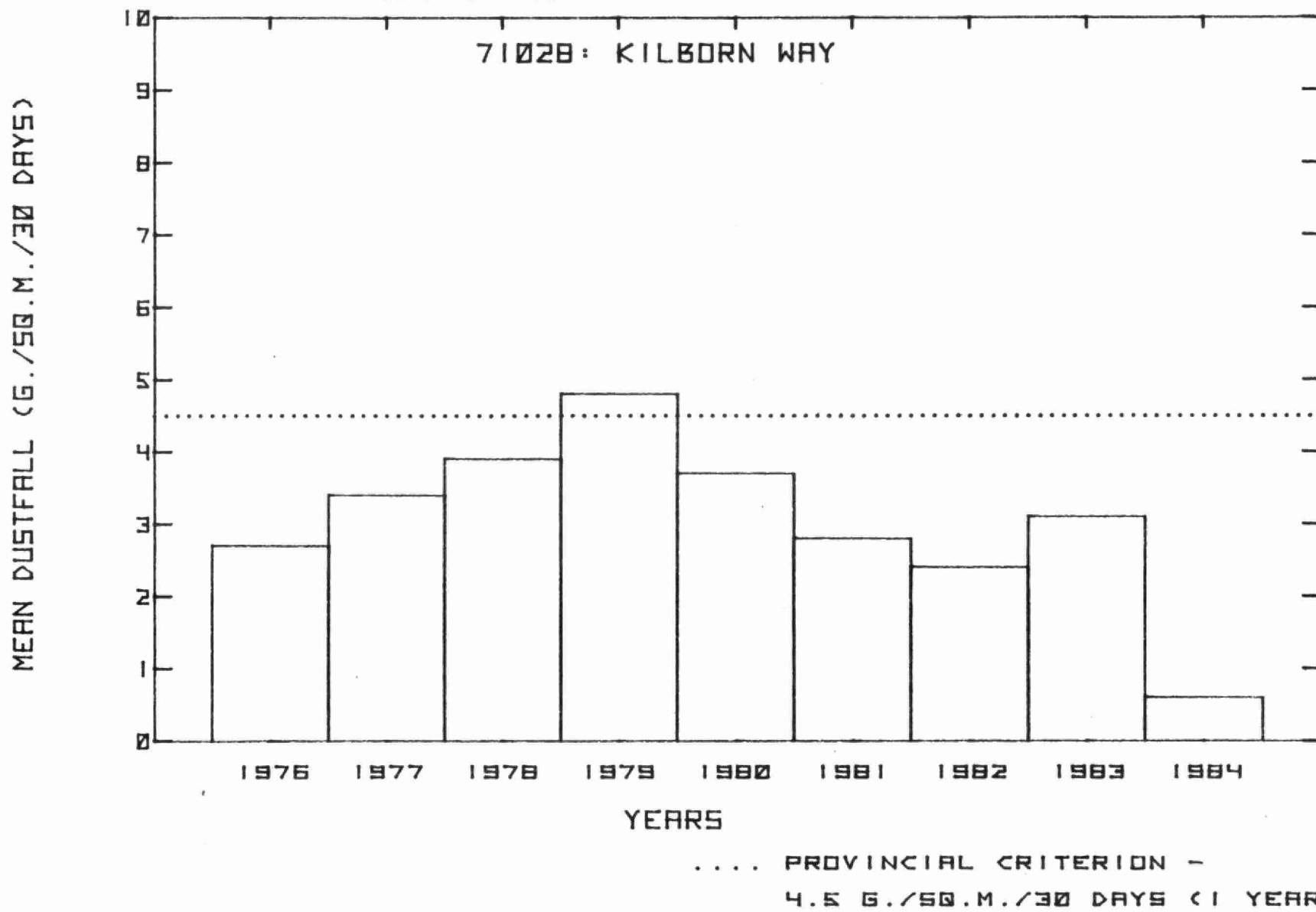


FIG.13.

PERIOD: AUG/1976 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

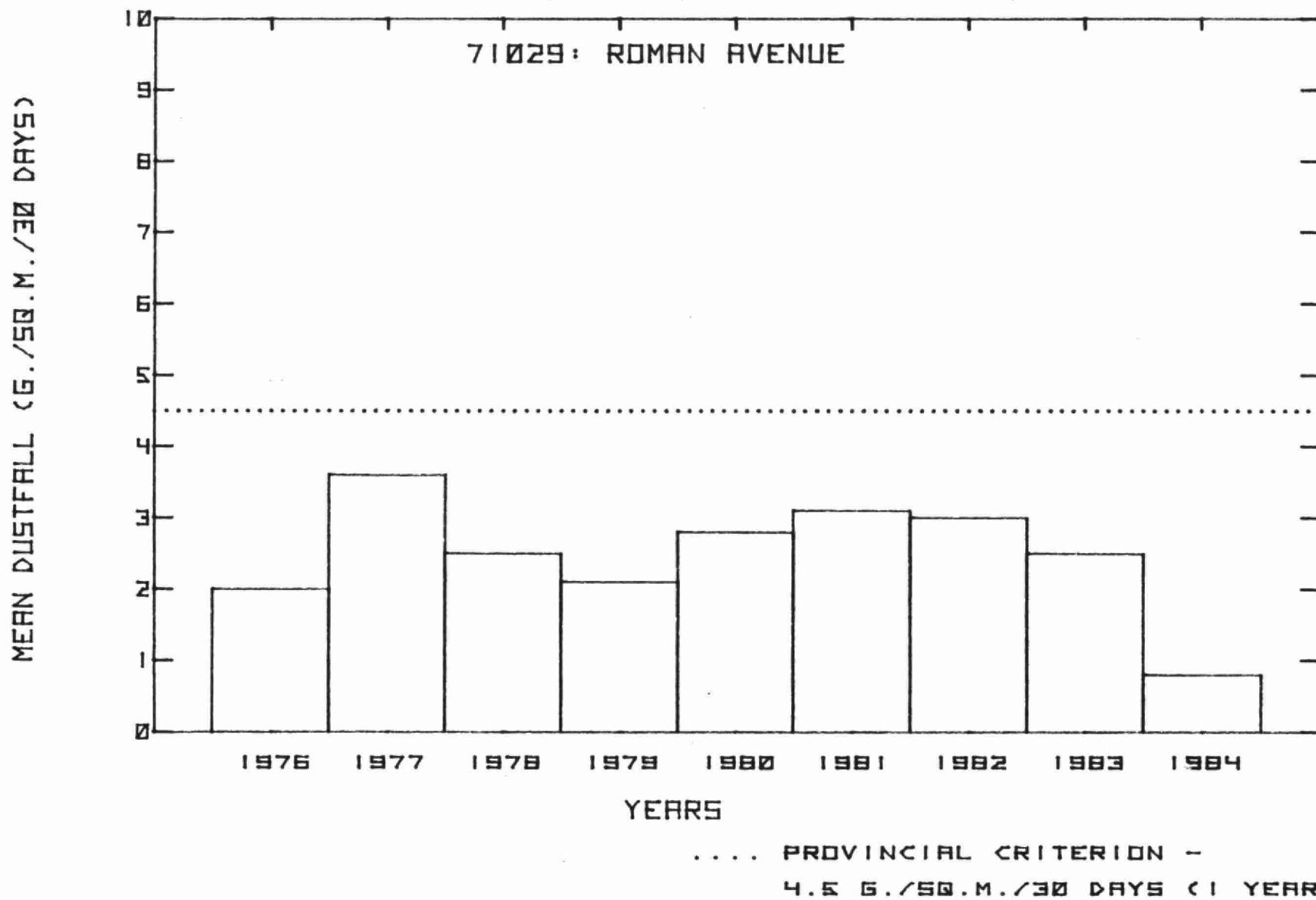


FIG. 14.

PERIOD: SEPT/1976 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

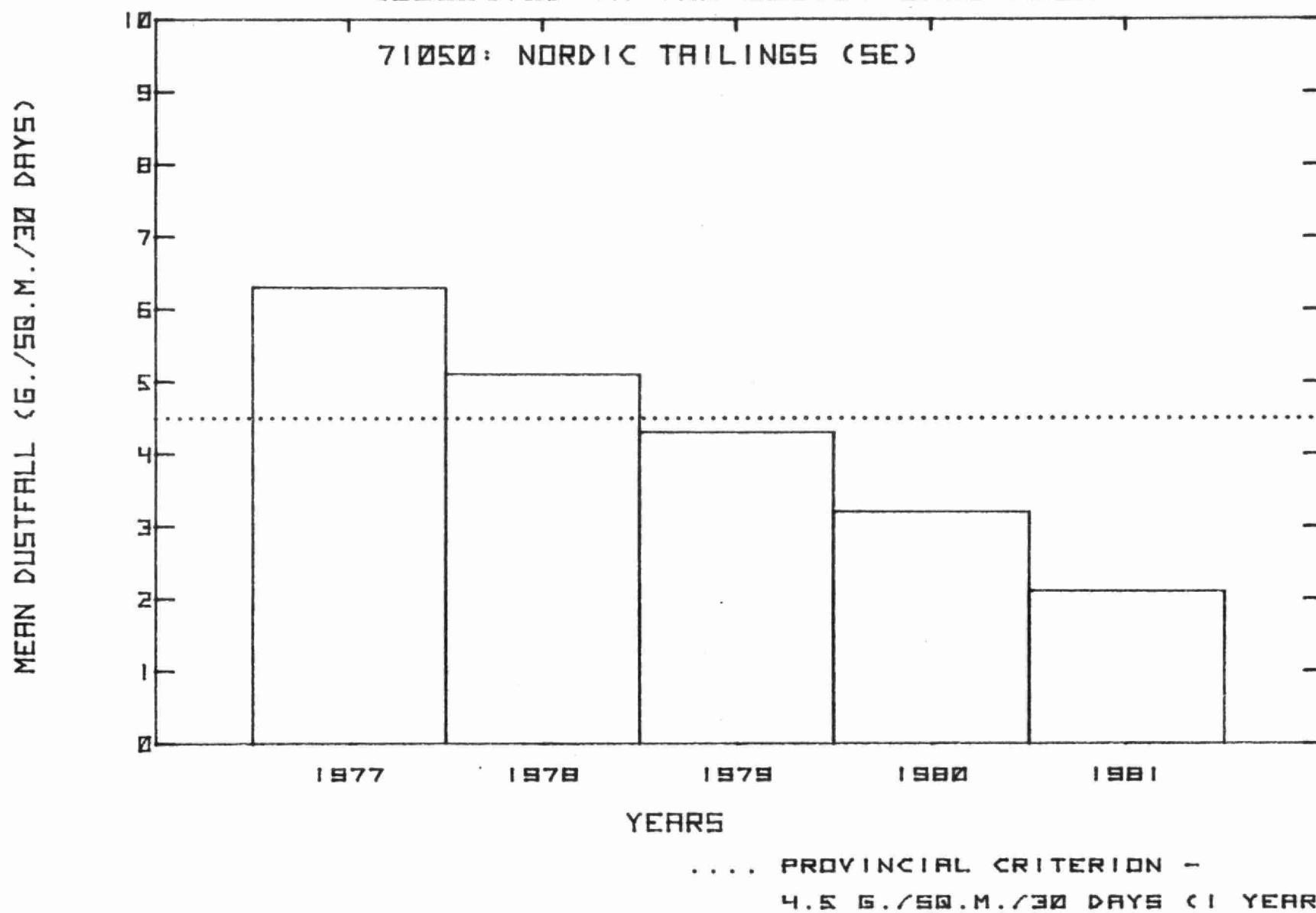
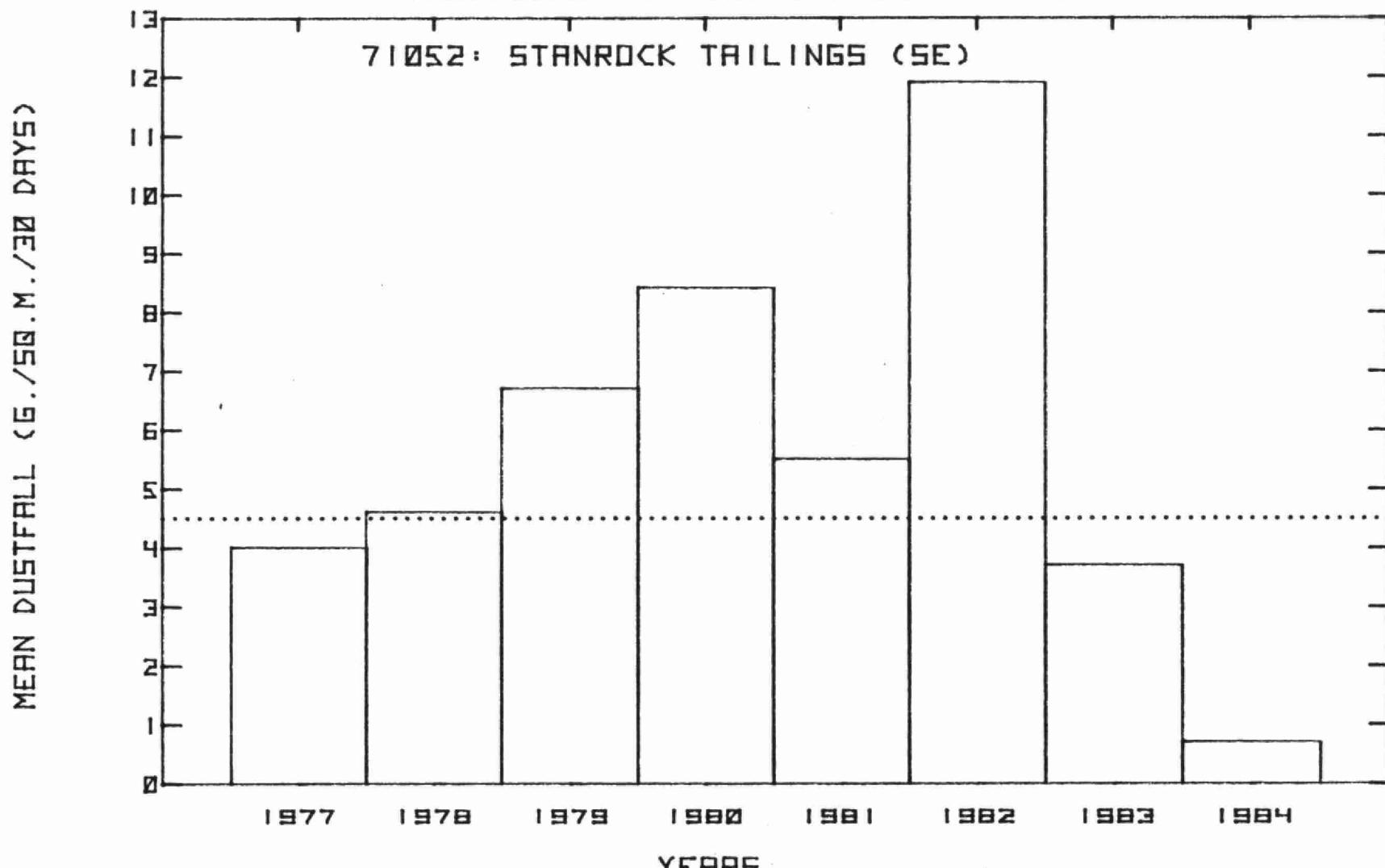


FIG. 15.

PERIOD: JUL/1977 TO MAY/1981

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA



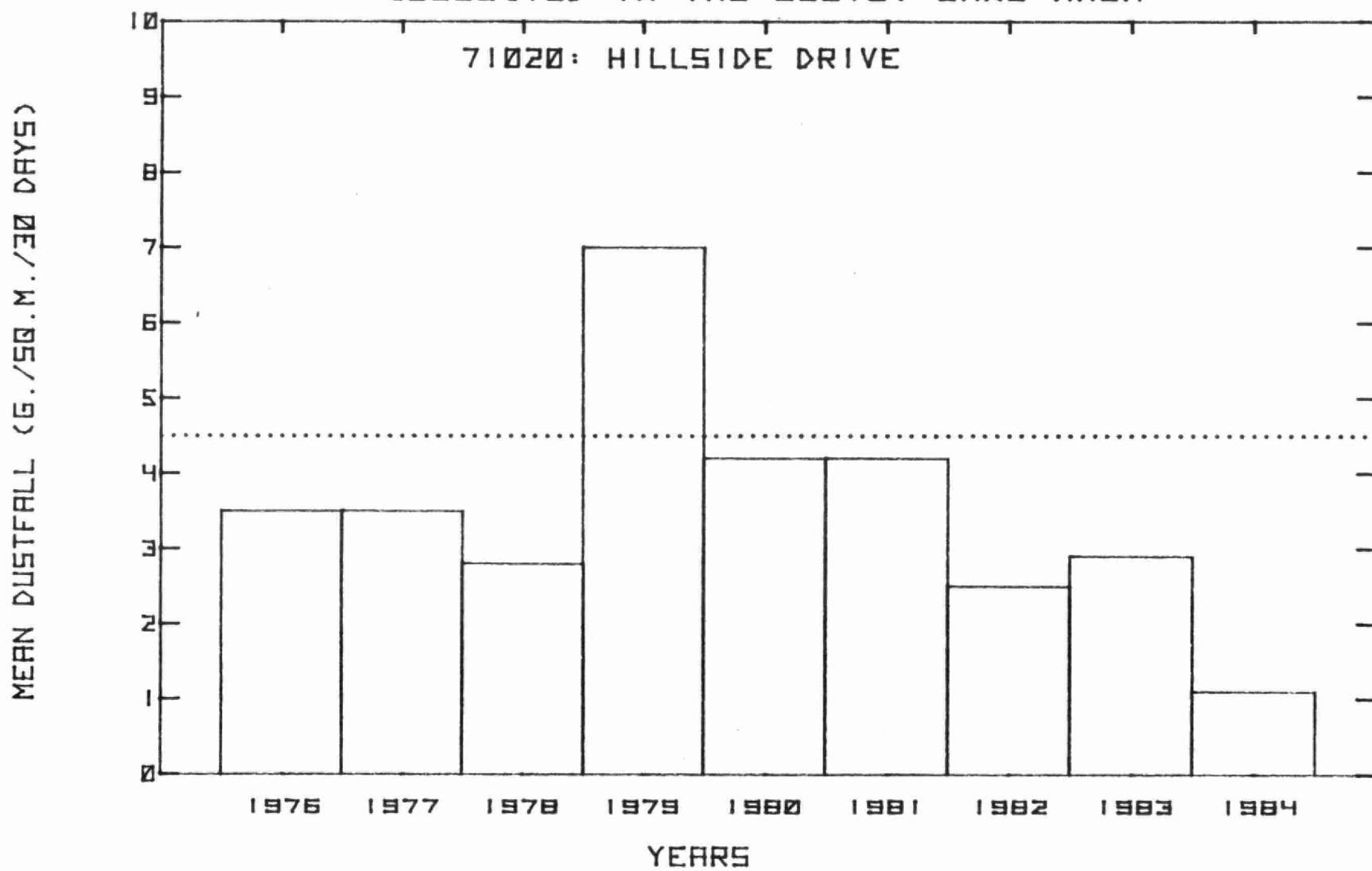
..... PROVINCIAL CRITERION -

4.5 G./SQ.M./30 DAYS (1 YEAR PERIOD)

FIG. 16.

PERIOD: JUL/1977 TO FEB/1984

ANNUAL ARITHMETIC MEAN OF TOTAL DUSTFALL
COLLECTED IN THE ELLIOT LAKE AREA

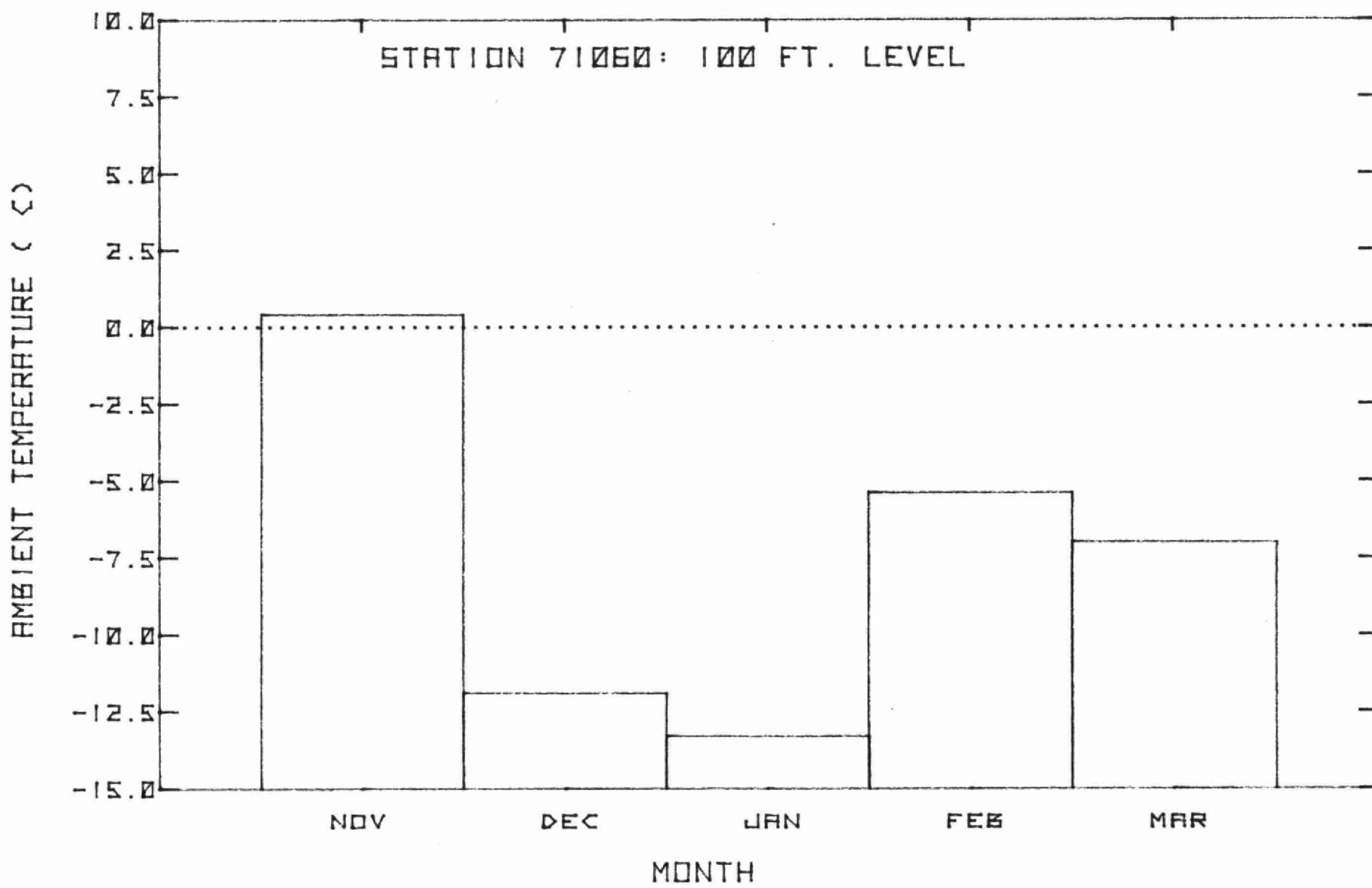


.... PROVINCIAL CRITERION -
4.5 G./50.M./30 DAYS (1 YEAR PERIOD)

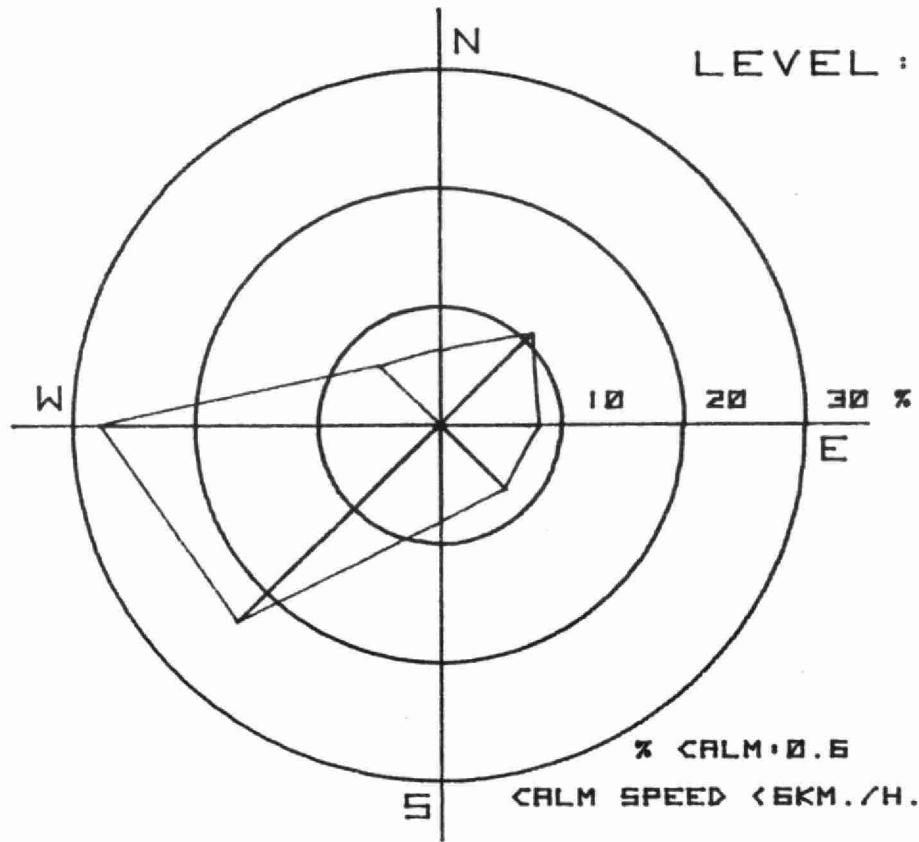
FIG. 17.

PERIOD: AUG/1976 TO FEB/1984

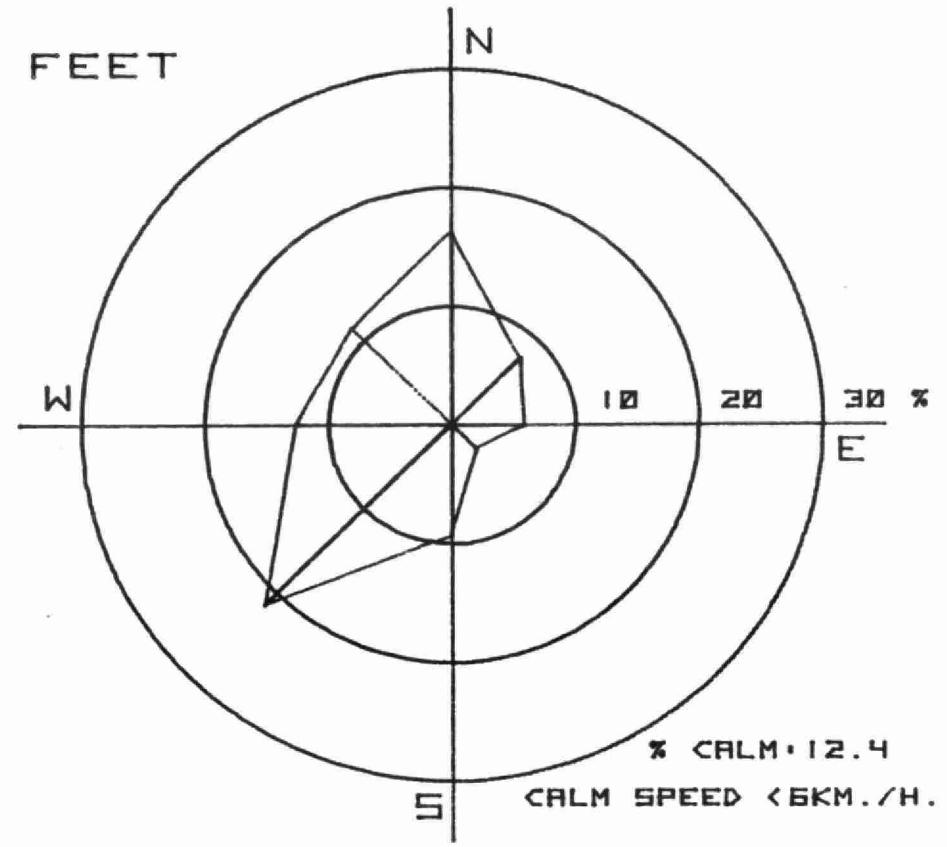
MONTHLY MEAN TEMPERATURES AT THE ELLIOT LAKE
MID-CANADA COMMUNICATIONS TOWER



MID CANADA COMMUNICATIONS TOWER HWY. 108



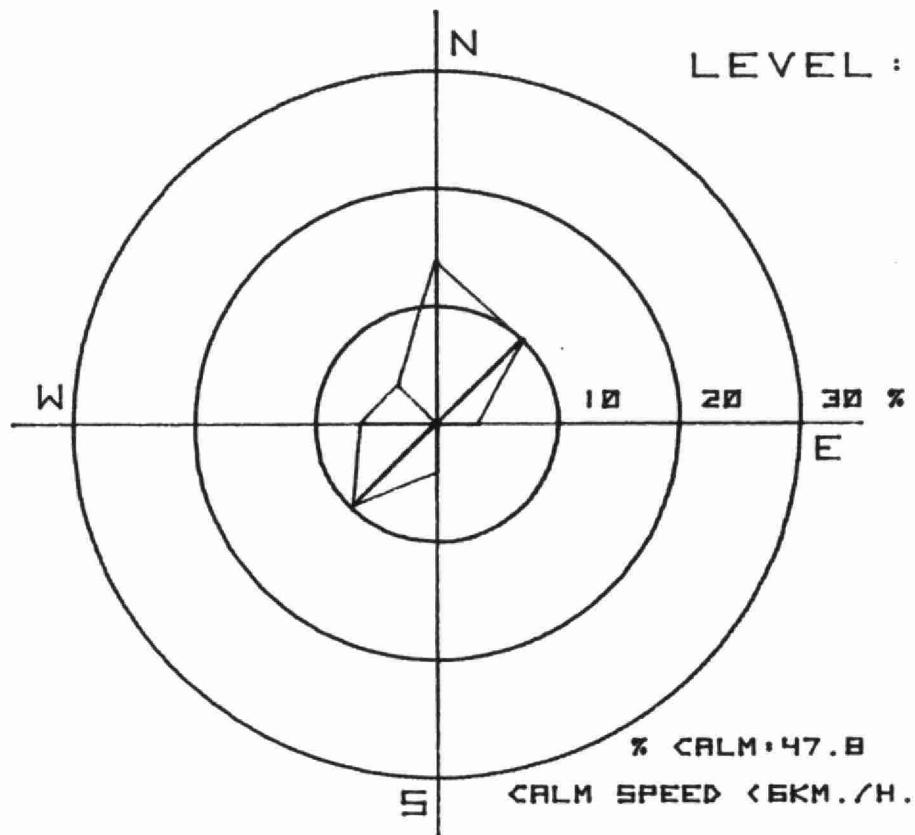
NOVEMBER 1983



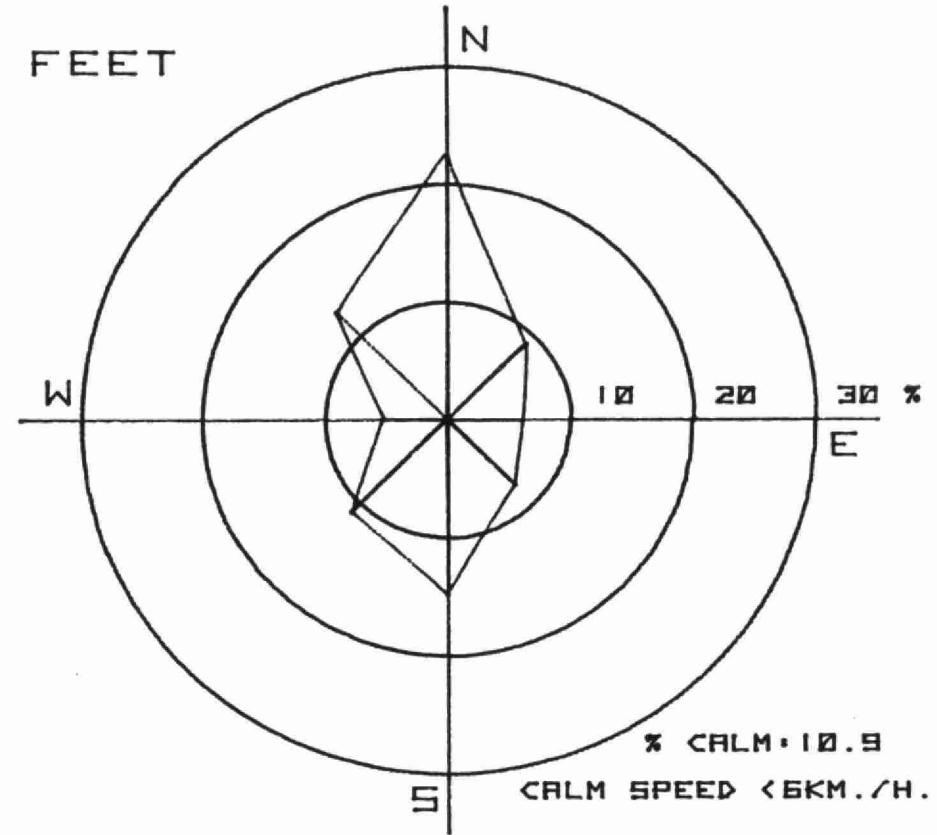
DECEMBER 1983

FIG. 19 MONTHLY WINDROSE FOR ELLIOT LAKE MET TOWER

MID CANADA COMMUNICATIONS TOWER HWY. 108



JANUARY 1984

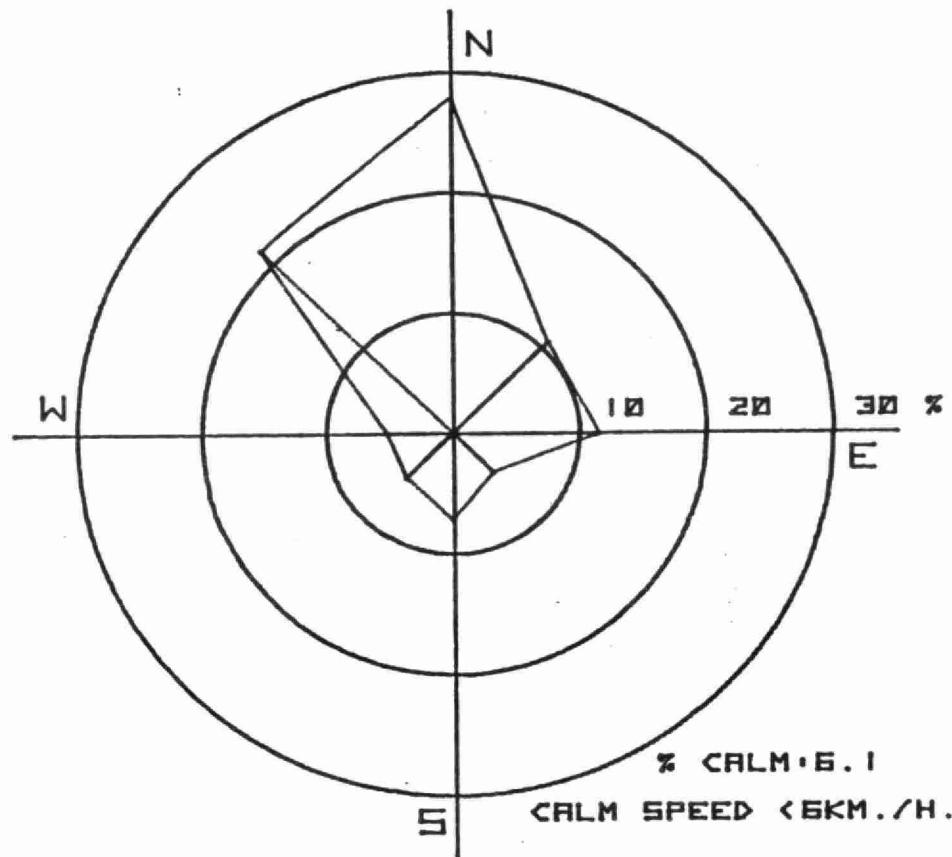


FEBRUARY 1984

FIG. 20 MONTHLY WINDROSE FOR ELLIOT LAKE MET TOWER

MID CANADA COMMUNICATIONS TOWER HWY. 108

LEVEL: 100 FEET



MARCH 1984

FIG. 21 MONTHLY WINDROSE FOR ELLIOT LAKE MET TOWER

APPENDIX A

Ontario Ministry of Labour
Air Monitoring for Radon Daughters

OUTDOOR CONCENTRATIONS OF RADON DAUGHTERS
AT QUIRKE TOWNSITE (71023) FOR 1982

<u>Period (1982)</u>	<u>Radon Daughters (WL)</u>
Jan 1 - Feb 5	0.0070
Feb 6 - Mar 9	0.0030
Mar 10 - Apr 27	0.0020
Apr 28 - May 27	0.0080
June 2 - July 6	0.0100
July 13 - Aug 18	0.0050
Aug 19 - Sept 21	0.0070
Sept 21 - Oct 27	0.0050
Oct 28 - Nov 30	0.0030
Nov 30 - Dec 31	0.0010
Number of Samples	10
Arithmetic Mean	0.0050
Maximum Value	0.0100

OUTDOOR CONCENTRATION OF RADON DAUGHTERS
AT DENISON TOWNSITE (71024) FOR 1982

<u>Period (1982)</u>	<u>Radon Daughters (WL)</u>
Dec 16 - Jan 28	0.0010
Feb 15 - Mary 25	0.0008
Mar 26 - Apr 27	0.0008
Apr 27 - May 27	0.0003
May 28 - June 29	0.0020
July 14 - Aug 18	0.0020
Aug 19 - Sept 21	0.0008
Sept 27 - Oct 27	0.0010
Oct 28 - Nov 30	0.0010
Dec 1 - Dec 31	0.0010
Number of Samples	10
Arithmetic Mean	0.0011
Maximum Value	0.0020

OUTDOOR CONCENTRATION OF RADON DAUGHTERS
AT NORDIC TOWNSITE (71054) FOR 1982

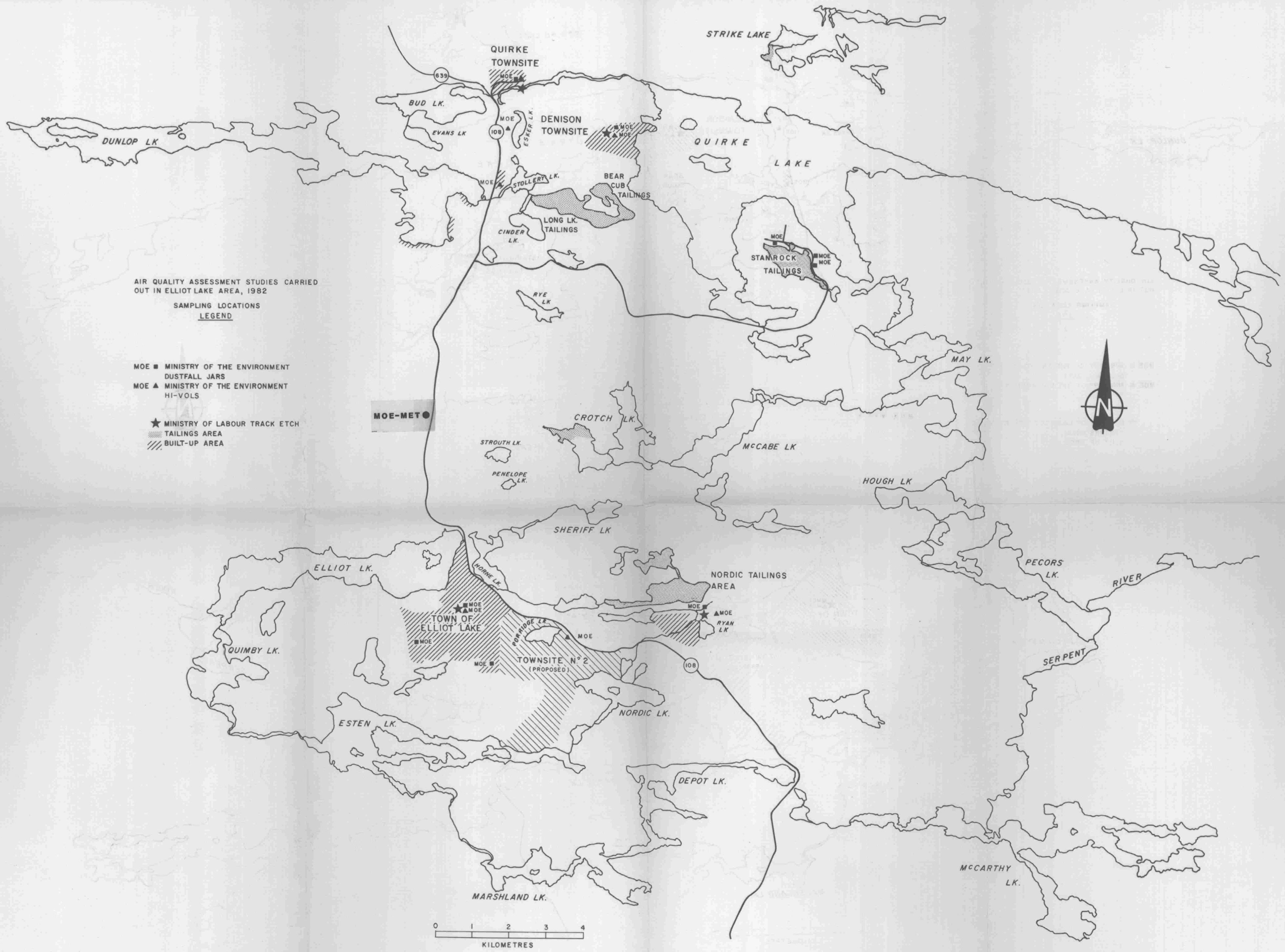
<u>Period (1982)</u>	<u>Radon Daughters (WL)</u>
Jan 7 - Feb 5	0.0007
Feb 6 - Mar 26	0.0007
Mar 26 - Apr 27	0.0006
Apr 28 - May 27	0.0002
May 28 - June 29	0.0050
July 1 - Aug 25	0.0050
Oct 22 - Nov 25	0.0010

N.B. Instrument vandalized - no data for September and December, 1982

Number of Samples	7
Arithmetic Mean	0.0019
Maximum Value	0.0050

OUTDOOR CONCENTRATION OF RADON DAUGHTERS
AT HILLSIDE DRIVE - ELLIOT LAKE (71020) - 1982

<u>Period (1982)</u>	<u>Radon Daughters (WL)</u>
Jan 7 - Feb 5	0.0010
Feb 6 - Mar 5	0.0009
Mar 5 - Apr 5	0.0005
Apr 5 - May 12	0.0006
May 13 - June 9	0.0010
June 10 - July 13	0.0010
July 14 - Aug 18	0.0009
Aug 19 - Sept 20	0.0009
Sept 21 - Oct 27	0.0008
Oct 28 - Nov 24	0.0010
Nov 25 - Dec 31	0.0008
Number of Samples	11
Arithmetic Mean	0.0009
Maximum Value	0.0010



ELLIO T LAKE AREA
COMBINED AIR MONITORING NETWORK

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